Vol 39 No 2 March/April 2014

ACOUSTICS BULLETIN

in this issue… **Speech intelligibility in higher education teaching facilities**

plus… **Back to the future – part 1**

Amplitude modulation – where are we now?

Estimation of uncertainty using revised draft ISO 1996-2

40 Institute of Acoustics

1974 - 2014

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ACOUSTICS BULLETIN

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Front cover photograph:
Good acoustic design is essential in teaching

Institute of Acoustics

The Institute of Acoustics is the UK's professional body for those working in acoustics, noise and vibration. It was formed in 1974 from the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society. The Institute of Acoustics is a nominated body of the Engineering Council, offering registration at Chartered and Incorporated Engineer levels.

The Institute has over 3000 members working in a diverse range of research, educational, governmental and industrial organisations. This multidisciplinary culture provides a productive environment for cross-fertilisation of ideas and initiatives. The range of interests of members within the world of acoustics is equally wide, embracing such aspects as aerodynamics, architectural acoustics, building acoustics, electroacoustics, engineering dynamics, noise and vibration, hearing, speech, physical acoustics, underwater acoustics, together with a variety of environmental aspects. The Institute is a Registered Charity no. 267026.

Conference and branch programme 2014

12 March
Organised by the Measurement and Instrumentation Group
Railway noise – on the right track
Birmingham

20 March
Organised by the Welsh Branch and the Wind Turbine Noise Working Group
AM and where to next for ETSU-R-97?
Newport

26 March
Organised by the Electro-Acoustics and Musical Acoustics Groups
Sound recording techniques and their influence on musical composition, interpretation, performance and appreciation
Salford

25 June
Organised by the Measurement and Instrumentation Group
How noisy is that machine?
London

17-19 September
Organised by the Underwater Acoustics Group
Third international conference on synthetic aperture sonar and synthetic aperture radar
Lerici, Italy

14-15 October
Organised by the Electro-Acoustics Group
Reproduced Sound 2014
Birmingham

15-16 October
Institute 40th Anniversary Conference
Birmingham

Please refer to
www.ioa.org.uk
for up-to-date information.

Dear Members

It is now a year since we held our 'strategy meeting' to discuss how we want to take the Institute forward over the coming few years. In developing our strategy we also took account of your responses to the 2012 membership survey.

Several initiatives have been developed over the past year to reflect the issues that emerged as having a high priority. Among these are changes to committee budgeting and reporting procedures, a new e-magazine aimed at students and of course the new website. On the whole most members have welcomed these initiatives which are working well and achieving their aims. However, we recognise that there are often unforeseen hiccups along the way when introducing change of any sort, and we welcome feedback from members so that any problems and misunderstandings can be sorted out.

One thing that we hoped to do was to raise awareness of noise and acoustics and to move it up the political agenda. To this aim we have signed up to a Parliamentary 'watch' service which alerts us to anything going on in Parliament which might be of interest or relevance to the Institute. The Institute has also been invited to become a member of the Parliamentary and Scientific Committee. The committee meets monthly in Portcullis House to discuss an issue of topical and scientific interest, and we can send a representative to attend each meeting. Topics to be discussed this year include badgers, biodiversity, marine science and A levels. The meetings are excellent occasions for networking and provide an opportunity for us to have an impact on the political agenda and to meet the MPs who influence the daily workings of Parliament.

Of course we also continue to engage with another major issue of the day – wind farms and the assessment of wind turbine noise. Our first one day meeting of the year continues the debate that was started last year with the publication of the *Good Practice Guide* on wind turbine noise, and there are likely to be more meetings on this subject later in the year. With intensification of the debate about climate change following this winter's floods and storms, there is likely to be increased interest in renewable energy sources, so noise from wind turbines remains a 'hot' (forgive the pun) topic.

In the autumn we were invited to become a sponsor of a film In *Pursuit of Silence*, which is currently being made by an American film company, Transcendental Media. After several meetings with the film producers and lengthy discussions in Executive and Council, we decided that not only was the film worthy of sponsorship but that it would be good publicity for the Institute as our logo would appear on the film credits. As part of the sponsorship deal we will be able, once the film is released next year, to arrange free screenings, not only for our own members at events such as local branch meetings, but also for the public and politicians.

Finally, you may remember that Peter Lord, one of the founder members of the Institute and a former President, sadly died in December 2012. The Institute is setting up a new award in his memory, to be presented annually to a building, project or product which is of a high acoustic standard. The award will consist of a plaque to be displayed on the building etc, acknowledging the team who are responsible for the acoustic design. It is intended that this will be another way of making acoustics and the Institute more visible to the general public. More information will be provided in the e-newsletter in due course. It is hoped to present the first Peter Lord Award at the 40th anniversary conference in October. Talking of which, I trust you have all submitted abstracts and put the dates in your diaries.

Bridget

Bridget Shield, President

Sustainable practice – the first steps

By Richard Cowell and Peter Rogers of the Sustainable Design Task Force

We are pleased to have received an endorsement and encouragement from Council to proceed with our proposal to contribute support to members in sustainable practice.

Our headline aims are:

- To encourage and support members to practise (whether involved with design, consulting, measurement, research or equipment supply) towards sustainable objectives
- To strengthen the profile of the IOA in this, now mainstream, professional expectation.

Our first move has been to link up with the specialist groups in a search for examples of good sustainable acoustic work by members. We are identifying these across all acoustic disciplines, and collecting short summaries.

We want to find strong examples of good practice, and a few examples of less successful attempts. We will then publicise these internally, to share with members, and externally to build the profile of the Institute in this area.

We see this as a simple mining exercise at first, but we would like your help in finding these. We are looking for progressive, not run-of-the-mill, examples.

Here are some topics to help prompt the identification:

- Creative sustainable use of materials
- Use of sound for health, well-being, safety and/or social inclusion
- Care for resources (whole life)
- Research/applications for energy savings
- Care for non-human life
- Waste reduction
- Maintenance of acoustic systems for durability/flexibility
- Local supplies and savings on transportation costs
- Sustainable land use planning
- Substantial reductions in carbon footprint
- Contribution to climate control
- Regulation re sustainable design
- Sound and crime reduction.

Although we see this as an ongoing process, we aim to have a good collection by the end of March.

Materials

We are making good progress in developing our first Sustainable Practice Guidance Note on material selection. This will provide members with headline points to check when making material selections or specifications, and will include signposts to authoritative, reliable reference material. We are also providing particular points to consider for materials and systems that are commonly used in acoustics. On completion of the first draft we will seek some peer review and invite feedback through a mini consultation, to gather any further thinking and then make it available to members via the website.

We are considering further guidance notes on a whole range of sustainable practice issues such as safety for acousticians, design for minimum waste, cost of "green" design, evidence of the impact of sound on health and wellbeing. We would welcome suggestions for other relevant topics from members.

Cross-disciplinary meetings

We are encouraging the development of multi-disciplinary collaboration (central to sustainable practice) through meetings, not only between specialist groups, but also, in particular, with other disciplines. In February Peter Rogers gave an update on the SDTF to the Creative Soundscapes event in Brighton, and we are now planning an event with CIBSE Lighting (The Society of Light and Lighting) in London in June, looking at the impact of light and sound on behaviour, health and wellbeing.

We aim to encourage the inclusion of more papers on sustainable design and practice in meetings. We look to stimulate momentum through the groups and branches, and will be finding various ways to communicate this to members, so that you can benefit from the collaborations and learning that results.

We are pleased to have a number of members who have volunteered to help us and more would be very welcome. Should you wish to get involved please contact either Richard or Peter at **richard.cowell@arup.com** and **progers@tecp.co.uk**

Full implementation of the IOA CPD scheme

By Ralph Weston and Mike Forrest

Professional development is the systematic maintenance and broadening of knowledge and skills, and the development of personal qualities necessary for the execution of professional duties throughout the working life. Institute members are under an obligation to maintain and extend their professional knowledge and competencies under the Institute's Membership Code of Conduct. Our website explains in detail the IOA scheme and provides examples for members to produce their own CPD records.

Accepting election to Institute membership implies a willingness to practise professional development and members who are seeking upgrade to MIOA or FIOA will be expected to demonstrate this. Members who have Engineering Council registration or who are members of certain other professional bodies are also obliged to do so in order to maintain their status.

There is no additional fee for taking part in the IOA scheme. The Institute will continue to issue attendance certificates at all conferences and seminars for those members who may wish to use them for other professional bodies or for personal record keeping. However, just counting up the number of points you have earned over the past year does not tell you what knowledge you have maintained or the skills gained. The new IOA scheme, which has been in development since 2000, aims to encourage members to consider their career and personal development and to make professional development into a regular planned activity rather than an occasional chore. The scheme is based on achieving personal goals relevant to your current employment and career, thus producing something really useful rather than a time-consuming pile of paper; it will give you the opportunity to consider how your professional development should proceed and will point out just what is needed.

The IOA will now establish an audit of members to show that we are maintaining CPD. From this year the IOA aims to review 10% of member CPD plans yearly. Around half of the plans will be reviewed automatically by the Membership Committee as part of the application process to become members of the IOA or to upgrade to a higher level. The remainder will be selected randomly by the Membership Officer who will ask those selected to submit their CPD plans electronically to the IOA for review. The review will be carried out by the CPD review committee comprised of volunteers from the CPD Committee, Membership Committee and the Senior Members' Group. Collection of plans will be done in stages throughout the year. Reviewers can approve plans or recommend improvements and ask for them to be re-submitted. If reviewers do not agree, the CPD plan for that member will be considered by the Membership Committee when they next meet.

Now – don't panic! Many people shrink their minds and switch off when they see "Continuing Professional Development" CPD written down, and assume it is just another unnecessary chore to be completed. All industries operate some form of CPD, whether identified in these terms or not. Even the *Farming Today* programme on the BBC was talking about CPD courses for farmers to keep up with the latest farming methods. Professional development is just the systematic maintenance and broadening of your knowledge and skills throughout your working life. It will help individuals in the progress of their careers and is therefore important to everyone.

Members submitting CPD plans should follow as near as possible the IOA guidelines on the website, and limit submission to no more than three or four pages. CPD is not a CV but a record of your current competences and your plan to maintain and develop your skills over the coming year. Not only will too many pages put off our volunteer reviewers but it will result in members being asked to resubmit.

Sponsor and retired members are exempt from supplying CPD plans. Members who are unemployed, on maternity leave and so on are expected to maintain their CPD as far as practical and allowances will be made. It should be noted, however, that most branch meetings are free and the IOA is developing a "webinar" service over the internet, both of which can be used towards your CPD plan.

It is essential for members to maintain and develop their knowledge and skills throughout their working lives and to be able to demonstrate this to their employers and customers. From the Institute's point of view we can confirm that the IOA is the leading professional body in acoustics and that being a member demonstrates your knowledge and skill in the profession.


CPD plan maintenance is vital

Interest in Engineering Council registration 'remains high'

By Peter Wheeler, Engineering Manager

Interest in gaining Engineering Council (EC) registration through the Institute remains high, with interviews held every few months, either face-to-face at the IOA offices or another UK site, or by video-link for overseas candidates. Support and advice is available by contacting the Institute at acousticsengineering@ioa.org.uk

With the fall in EC-accredited degrees in acoustics in the UK, more and more candidates are applying via the "individual route", which requires further preparatory work for them in submitting evidence of their competence, but advice and support is offered to every candidate. The election process is overseen by the Institute's Engineering Division Committee, comprising some of the 300 or so members holding EC registration.

Below are profiles of two candidates who have recently gained EC registration via the IOA.

Alex Campbell, WSP, CEng

Alex graduated from the Institute of Sound and Vibration Research (ISVR) in 2004 and began a career in consultancy with Buro Happold, Bath. In 2007 he joined WSP, working from Bristol then London.

In 2011 he transferred to the WSP Sydney office in order to start and lead the WSP acoustics team in the Asia-Pacific region. He specialises in architectural acoustics and has been involved with the delivery of many projects across all sectors, with current highlights including Sydney International Convention, Exhibition and Entertainment Precinct and Walsh Bay Arts Precinct.


Alex Campbell

He has presented at Reproduced Sound and has co-authored papers for other IOA conferences, along with having written a number of articles for the press – including the *Architects Journal* in the UK and the *Planning Institute of Australia*.

"Seeking CEng registration is something that I saw as critical to my career development, especially in a market such as P8

◂P7 Australia, where the industry is currently going through a process of 'tightening up' on professional accreditation and more and more clients are demanding certified professionals to sign-off designs," he said.

"Seeking chartership in a specialist discipline here can be very tricky. Going through a body like Engineers Australia would have been a very long, drawn-out process due to the body not having the process in place to assess acoustic engineering expertise and experience. I found the IOA process very smooth and the notes that were provided in translating the EC_{UK} requirements into something specific for acoustics (with examples) invaluable. This made writing the Professional Practice Report and demonstrating the requirements much easier."

Dr Gary Seiffert, University of Liverpool, CEng

Gary joined the University of Liverpool as a trainee electronics technician in 1980 and gained TEC and Higher TEC qualifications in electronics. He moved from electronics into acoustics after successfully completing the IOA Diploma in 1984. He graduated with an MSc by distance learning in Acoustic Vibration and Noise Control from Heriot-Watt University in 1991 and completed a part-time PhD researching the interaction of sound with powdered material at the University of Liverpool in 2009. He is now a Senior Research Fellow in the Acoustics Research Unit within the School of Architecture.

"My role is to provide research support for grant holders and PhD students within the unit, undertake personal research, provide CPD courses in acoustics and undertake consultancy projects that inform our research," he said.


Dr Gary Seiffert

"I must admit that I had been thinking of applying for CEng status for quite some time but didn't get around to it. The process of registration is rigorous and can seem daunting but the guidelines are clear and the assistance of the IOA Engineering Manager (Peter Wheeler) makes the process flow smoothly. Acoustics is a subject that fits into many areas of education and industry and is not always well understood by the public. In my opinion this makes professional recognition all the more important for those working in the field."

STEM in the spotlight: lights, camera, and action!

By Emma Shanks, Noise & Vibration Team, HSL, Buxton

In June 2013 I received an email from STEMNET telling me that they had commissioned education specialists EdComs to create a set of training films to help share good practice and inspire STEM Ambassadors. Following national consultation for potential participants in the films my local STEMNET contract holder, Derbyshire Education Business Partnership (DEBP), nominated me with the Institute's "You're Banned" acoustics activity. "You're Banned" is an acoustics design challenge, to build a rehearsal room on a budget, given some basic principles of sound and wave motion and material properties.

In October a very obliging Head of Science and a fantastic Year 8 group welcomed me, the "You're Banned" activity and the EdComs film crew into Buxton Community School, for the first of the film shoots. Within seconds of the film crew setting up the rumour ran round the school that "Educating Yorkshire" were in the building – must have a word with the geography department…

It was an interesting day to say the least, and a steep learning curve all round. Although the activity had been arranged for the purposes of filming, my primary objective was still that of a STEM Ambassador, to deliver an interesting and inspiring learning activity for pupils. This didn't always align exactly with the filming process! For example, I didn't realise that the removal of an outer layer of clothing during the activity set up compromised film continuity. My proffered explanation that not fainting from heat stress was more important to me than continuity seemed reasonable to me! However, we quickly found mutually acceptable ground – and I quickly learned that when wearing a lapel mic the sound recordist is always listening.

As well as filming the actual "You're Banned" activity, I was also interviewed for some top tips and lessons learned; we also filmed some shots of me "at work". The latter of these involved me switching equipment on and off, preferably equipment with lots of little LEDs on the front (our B&K 1049 signal generator was a particular favourite), and walking in and out of our anechoic chamber a few times. But when put into context that these images would go underneath some of the spoken interview I was beginning to picture the final product.

Eight hours later and the film crew were heading back to their hotel for the night, and I'd had "just another day at the office, dear". Delivering the activity to the Year 8 group was just marvellous – as it has been for every group with whom I've had the pleasure to interact. STEM work is very fulfilling, and is made particularly easy when you've such a brilliant activity as "You're Banned" to use. So many thanks to Richard Collman, the activity inventor, and also thanks to the IOA Education Committee for persuading and supporting Richard to make a whole set of "You're Banned" boxes so more STEM Acoustics Ambassadors can spread the STEM word.

If you want to find out more about the "You're Banned" activity and what STEM (Acoustic) Ambassadors get up to, please call me (**01298 218384**) or email me at **emma.shanks@hsl.gsi.gov.uk** For more general information on the STEM Ambassador programme, look at the national STEM Ambassadors website **http://www.stemnet.org.uk/**.


Emma Shanks with Year 8 pupils at Buxton Community School

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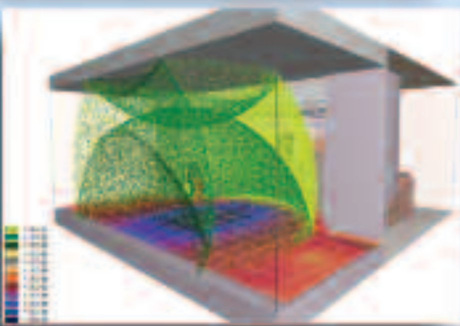

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Lily finds Inspiration at women's engineering conference


Lily Nikolova

Lily Nikolova, a music studio technology student at Southampton Solent University, recently took up the offer of an IOA-sponsored place at a Women's Engineering Society (WES) conference for students at Aston University entitled Engineering Inspiration. Here she looks back at the event and explains what she took from it.

"After hearing about the conference from the Institute, I decided that attending would not only help me get a clear insight of industry but help me make contacts beneficial for my final year project and my career.

After a welcome from the WES President, Carol Marsh and other introductory talks, we were presented with panels made up of representatives of EDF Energy, Rolls Royce, Arup and other major organisations. The day concluded with networking exercises and a dinner where we were we were able to share opinions and experiences and to get know each other better.

The second day followed a similar format, with more talks and networks involving both industry professionals and graduates. It finished with a postgraduate forum for networking, discussion and professional registration, where attendees were encouraged to become members of WES.

Topics covered during the conference included how to attract and retain more women in the industry, what employers usually look for in a future employee, the advantages and disadvantages of having diverse teams and how women perform in the workplace compared with men. With carefully prepared statistical and sociological data, the presenters introduced us to various problems and even produced viable solutions to many of them. With talks from civil engineers, energy management professionals and other scientists, the event presented a range of opinions on these questions while also revealing some little known facts on the topics being discussed.

So how useful was it to me? Although there were no presentations directly related to acoustics or sound engineering, I found the experience helpful and informative in terms of gaining a better understanding of how big companies work from people with significant amounts of experience. I would recommend attending future WES conferences to anyone interested in taking part in discussions about balancing the family and work, employability and what is needed to become a successful woman in the engineering industry."

Sky's the Limit for Young Members in Manchester

By Michael Lotinga

The Young Members' Group has held two successful events recently in the North West.

The first, an informal social get-together for youthful attendees of the Reproduced Sound event at the Renaissance Hotel, Manchester, drew some thirsty academics and professionals for lively post-conference exchange and debate.

The second was a larger event organised in collaboration with other institutions representing disciplines closely involved with the "built environment", including the IOA, ICE, IStructE, RTPI, CIOB, CIBSE, the Landscape Institute and Urban Design Group. Around 130 young professionals made their way to the 24th floor of the Co-operative CIS tower, overlooking the brightly lit Manchester city nightscape for an evening of cross-industry connecting and entertainment. The title of the event, The Sky's the Limit, reflected both the venue and the activities, which included a skyscraper quiz and the chance for teams to demonstrate their skill in constructing mini-towers. Food, drinks and music were laid on and the evening proved to be a great success. The organising committee are very grateful for the sponsorship of the above institutions and the Construction Industry Council North West.

To keep up to date with Young Members' Group events by email, log into your account on the IOA website, click on the My Account tab, and choose Young Members from the drop down menu underneath Your Groups.


Members enjoy themselves at the "built environment" event

Demand for environmental noise measurement course 'remains high'

The academic year 2013/14 is the second year in which the IOA is offering five short courses.

The demand for the Certificate of Competence in Environmental Noise Measurements remains very high [184 students (170 passes)]. The syllabus has been modified to take account of the current interest in noise from wind power plant.

The Certificate of Competence in Workplace Noise and Risk Assessment recruited 42 students (35 passes). Discussions are under way to explore possible collaboration with IOSH who run a similar course.

The Certificate of Proficiency programme in Anti-Social Behaviour (Noise) continues to be run in Scotland by Bel Education who recruited 32 students (28 passes) in autumn 2013. It is hoped that Strathclyde University will run it this spring.

The third year of the Certificate of Competence in Building Acoustics Measurements has seen 19 students recruited (17 passes), the only active accredited centre being Southampton Solent University. The demand for the Management of Hand-Arm Vibration course continues to be low. In 2013 nine students were recruited with six passes.

Antisocial Behaviour Act 2004 Noise Measurements

Bel Educational Noise Courses
Anderson B
Askew C A J
Black J
Carson K W
Colquhoun N
Devlin W F
Donald P D F
Downie A C
Dunn W
Easson J
Ferguson C W
Henderson A D
Johnstone D
Leslie R
McBurnie P
McEwan M
McKellar L
McMahon D
McPhee J
Patterson M L
Senior A T
Sharkey C M
Smyth P
Sticklings A G
Thom R
Timoney J
Turnbull R F R
Wilson P

Building Acoustics Measurements

Southampton Solent University
Lee P J D
Nixon S J G
Pabyal S K
Reilly J D
Robinson H
Taylor C
Thompson M

Environmental Noise Measurement

University of the West of England
Broad P
Brown E C
Carpenter L A
Jenkyns R
Lane A
McClean C
Oman S
Rawlinson S
Smith D
Vickers S
Wright D
Wright C

Colchester Institute
Allen D
Cant D
Ellis V M
Francis N
Nicholson S L
O'Connor C M
Olero B
Sambells R C

Leeds Metropolitan University
Asghar I
Bernhardt R
Bolton R S
Demaline G R
Gardham J E
Giles M
Maclean A A
Stainton R M
Tansley R M
Turner T

Liverpool University
Bett A J
Bingham A
Eldret E L
Evans J D
Filippoupolitis M
Hoeltzenbein N I
Jang H
Ridehalgh J S

NESCOT
Adjei E
Beattie A
Chambers S L
Devine A T
Diss R A
Greest D C
Meakins A C
Overy N J
Town G A
West A S
Wilkinson N J

Shorcontrol Safety
Byrne M
Cooney B
De Cleir S
Goggin A
Healy T
Jennings J S
McWilliams J
Sutcliffe R T

Southampton Solent University
Brown P R
Hayes-Arter S
Samuel R B F

University of Strathclyde
Findlay D
Fitzgerald M R
McWhinnie M J
Smith J A

Workplace Noise Risk Assessment

Leeds Metropolitan University
Cunningham M A
Nixon M

EEF Melton
Edwards D K
Glen I
Hughes R
Incles R
Monaghan L
Rose P J
Smith C M
Sutton M B

Shorcontrol Safety
Byrne G
Connor R
Cooke J E
Fitzpatrick C
Goulding J
Leonard E
O'Connell D
Robinson B
Savage K

Project titles for 2013 Diploma in Acoustics and Noise Control

The following are the titles for projects submitted for the 2013 IOA Diploma in Acoustics and Noise Control.

DL St Albans

- Predicting music festival noise using computer modelling
- Achieving special educational needs, acoustic standards in thermally activated designed classrooms
- Reduction of a noise emanating from a plant room housing multiple building services equipment
- An appraisal on two external weather louvre systems with acoustically absorbent blade elements
- An investigation into the behaviour and contributions of primary and flanking elements in room-to-room sound transmission
- Investigation into non-linear frequency contributions and gender-specific effect for rating the speech privacy of meeting rooms
- A study of noise exposure levels, noise transmission, and identification of appropriate noise reduction techniques in a residential property
- An acoustic assessment of a new skate park in Brighton: does reality match the modelling?
- Effect of material thickness on the dynamic properties and impact isolation performance of recycled rubber floating floors under loads below 10 Kn/m2
- A study of the use of flexible noise barriers at a construction site in Singapore
- An assessment of internal and external aircraft noise exposure levels at Cranford Junior School, Hounslow
- Investigating the acoustics environment of the main hall, Community Church, Bishops Stortford
- To investigate the effectiveness of a noise management plan, at abating statutory nuisance at a clay pigeon club
- An investigation into the reliable measurement of reverberation time

- An investigation of noise within an open plan office
- Study to assess noise limits on demolition and construction sites in the London Borough of Islington
- A comparison of sound pressure levels before and after installing an acoustic enclosure to a standby power generator set
- Noise levels in a residential garden: Is there a “typical” background level, and what impact could the level have in the regulatory compliance of EPR regulated processes?
- The measurement and calculation of reverberation times in teaching spaces

DL Bristol
- An investigation into the performance of line and point source loudspeakers system
- Investigation into the repeatability of airborne sound insulation testing in an acoustic transmission suite
- Investigation into speech intelligibility in hospitality venues
- Noise impact assessment of night-time helicopter activities
- Reducing noise from a basement pool pump

DL Edinburgh
- Assessment and acoustic treatment of home cinema.
- Directivity of wind farm noise at noise sensitive receptor distances
- G and C50: Measurement and protection in non-diffuse spaces
- A review of environmental noise barriers through prediction and measurement
- A heated discussion of indoor noise levels
- How do recommendations following regulation guidelines compare to subjective experience
- Measuring personal noise exposure from use of the hand held petrol driven leaf blower
- An evaluation of the impact of noise from the new Borders railway on noise-sensitive receptors in Midlothian

DL Ulster
- Comparison of narrow band FFT analysis, and 1/3 octave band analysis, for tonal, assessment of industrial, sources at nearby sensitive receptors
- An assessment of the noise impact from metal and an evaluation of noise mitigation measures to reduce noise impact in an urban residential environment
- Outdoor entertainment noise assessment of Londonderry Park
- Assessment of traffic and rail noise for residential development proposal
- Investigation into noise from late and early flights to and from Belfast City Airport
- An evaluation of the performance of an acoustic barrier in mitigating train maintenance noise in an urban residential environment
- Noise Impact of a scrap metal processing baler/shear machine
- Office acoustic design considerations and insulation testing of the design
- Attenuation performance of hearing protectors for impulse noise in the Irish defence forces
- Noise impact assessment, Carlingford Ferry Project

DL Southampton
- Critical evaluation of the assessment of entertainment noise from pubs and clubs in a suburban environment
- Noise control legislation and houseboats: an investigation and case study
- Effect of bridge-mounted mutes on level and spectral output of a violin
- Feasibility and design of a modular music practice/recording room
- Development of sound masking loudspeakers
- Design of an acoustic attenuation package for an air conditioning
- A feasibility study into the design of an acoustic solar shading system
- Investigation and reduction of reflections from microphone array structures for 10th scale jet noise measurements up to 100kHz
- Impact assessment of traffic flow from an industrial sit, incorporating measurement and modelling
- Acoustic specifications for naval simulators

DL Derby
- Noise assessment of drop hammers
- Acoustical properties of schools
- Acoustic performance of weather hoods
- Acoustic reinforcement in lecture theatres
- Assessment of off road armoured vehicles
- Comparison of insulation performance of different materials
- Environmental noise impact of air source heat pumps
- Acoustical properties of Nottingham caves
- Smartphone applications for use in noise assessments
- Noise levels from vacuum cleaners
- Audiometric testing of Environment Agency officers
- Impact of town by-pass-on noise levels
- Review of natural materials
- Noise impact of wheel loading shovels
- Noise control of BT telephone exchange buildings
- Noise exposure levels of a match day steward
- Assessment of cabin noise in motor vehicles
- Design and build of vocal booth
- Sound reduction properties of lightweight materials
- Assessment of low frequency noise
- Noise from ventilation systems
- Acoustic performance of an enclosure
- Noise exposure levels within Cineworld theatres

Leeds
- The suitability of swimming pools as teaching spaces
- An assessment of noise for site suitability
- The behaviour of room equalisation filters
- Sound insulation of private offices
- Noise levels emanating from a commercial grain dryer
- How room acoustics affect speech intelligibility
- The sound insulation properties of a movable wall
- An assessment of Stead Hall firing range

Salford
- Comparison of Calculation of Road Traffic Noise (CRTN) values between noise mapping software and on-site measurements
- Acoustics of an open plan office
- Assessment of Isolation requirements for a music complex
- Road traffic noise assessment, comparison of field measurements, noise prediction calculations and noise modelling undertaken in accordance with the CRTN prediction method: a case study approach

DL University of West of England
- Investigation into the acoustic design of an audio editing/music production room
- Sensitivity analysis of ground modelling used in noise maps for CRTN
- Investigation into acoustic insulation for oil and gas pipelines

In search of silence

Midlands Branch report

By Kevin Howell

In November the branch returned to the URS offices in Nottingham for its AGM and a presentation entitled Silencer Design by Gary Turner of Cullum Detuners.

He began by outlining the heritage of Cullum, an engineering company whose silencers and detuners are now used worldwide. Gary showed photos and design sections of a variety of installations in many countries, which include major onshore and offshore projects for the oil and gas industries, power generation and test installations for aircraft engines. He described some of the specific design requirements for these projects. Many of the silencer installations are huge multi million pound engineering projects in their own right.

Gary presented a number of basic principles of silencer design and emphasised that these are well known and understood and can be found in numerous text books. However, their P14

◂P13 application to real problems often requires the development of manufacturing and construction techniques which enable the silencer to cope with extremely onerous operating environments. A silencer must permit the passage of a fluid, often at very high temperature and/or pressure, whilst attenuating the high noise levels produced by the process. The designer must, therefore, trade aerodynamic and engineering performance against acoustic performance in arriving at the optimum solution for the particular application. Gary showed some of their in-house acoustics, flow modelling and engineering software capabilities. The designer must also consider, of course, the capital and operating costs of the installation for the end user.

Proof of design cannot always be accomplished on the bench, in the laboratory, or by computer analysis, and so must be done through prototyping and validation at full scale in the field and on live contracts. Thus there exists a level of risk which can only be mitigated by adhering to fundamental design rules derived from many years of experience. Gary showed examples of what can go wrong when the engineering or acoustic design is not quite right.

Thank you to Gary for his presentation and to URS for hosting us once again. Further discussion followed over an excellent curry accompanied by live music. This was the first Midlands Branch meeting to be available as a webinar, and the 30 or so attendees were joined by a further nine participants on the web.

North West Branch reports

By Michael Lotinga and Dave Logan

Reverberation time and speech intelligibility in a reverberant conferencing facility

North West branch held its AGM on a cold evening in November at BDP in Manchester. Following the Chairman's report, delivered with characteristic conviviality by Peter Sacre (AEC), something of a changing of the guard took place. Peter, having acted as Chairman for more years than he would care to admit, announced his stepping back. Also stepping down as another similarly long-standing/suffering committee member was Paul Michel, who retired as Secretary. Elections were then held, with Michael Hewett (AECOM) chosen as Chairman and Michael Lotinga as Secretary. The branch also welcomed new committee members Keith Vickers (Brüel & Kjær) and David Terry (Atkins). Under extreme duress, Peter Sacre graciously agreed to continue as a backbench member of the committee. The branch held five meetings in 2013 with an average attendance of 28.

After the AGM, Derek McGlaughlin (Acoustix) presented a study submitted as a project for the IOA Diploma: a summary was given of the investigative work carried out to determine appropriate acoustic treatment to promote intelligible speech in the teleconferencing facilities of a major blue chip company, and a discussion on the constraints and challenges imposed by these types of rooms ensued.

The branch extends its grateful thanks to Derek, to BDP for providing hospitality, and to Peter Sacre and Paul Michel for tireless and capable stewardship of the branch.

Designing tranquil spaces

In January Professor Greg Watts from the Bradford Centre for Sustainable Environments, University of Bradford, spoke about the concept of tranquility and the techniques that can be used to design or improve the tranquility of spaces.

Such spaces are important as they provide a restorative environment for people to unwind from the stresses and strains of everyday life, a fact recognised by the London Health Commission. In addition, Ulrich in 1984 demonstrated much faster recovery rates and lower requirements for pain relief for surgical patients who had recovered in rooms looking out over a natural scene than those whose view was a brick building wall.

Changes in blood flow through the brain can be observed using fMRI (functional magnetic resonance imaging) and experiments have shown that the brain processes similar sound signals differently when there is also a visual stimulus to accompany the sound.

The perceived tranquility of a place seems to be affected by three main factors, namely the soundscape, the landscape and moderating factors. The more "natural" the features then the less likely it is to be rated as negative, e.g. waves breaking onto a beach may lead to relatively high sound levels but the area would still be rated as tranquil.

For tranquility research studies, video clips were obtained using binaural recording over a wide range of rural, urban and city landscapes. Subjects watched the replays in an anechoic chamber equipped with headphones and a large plasma screen and gave each a tranquility rating (TR) using a 1-10 scale.

A model was developed showing the relationship between acoustical and visual features, known as the Tranquility Rating and Prediction Tool (TRAPT) and gave rise to the following equation:

$$TR = 9.68 + 0.041\,NCF - 0.146L_{day}$$

where NCF is the percentage of natural and contextual features and L_{day} is the predicted average daytime noise level (0700 – 1900) from the major noise source (usually road traffic).

The value of NCF is obtained by overlaying a grid on a series of contiguous photographs to give a 360 degree view.

Validation of TRAPT was done at various locations by questionnaire and interview and good correlation was found between predictions and actual ratings given. Greg has suggested provisional guidelines with <5 being unacceptable, ranging to >8 being excellent. Values of 5.0 to 5.9 would be considered just acceptable.

The model can be used to design tranquil spaces, or to assess improvements to areas considered to have marginal tranquility, as it could be argued that improvement to the most accessible areas will bring the greatest benefit. The following would need to be considered:

- **(a)** reducing man-made noise,
- **(b)** increasing the percentage of natural and contextual features,
- **(c)** moderating factors.

Options could therefore include siting an area away from noise sources, provision of suitable screening if appropriate, provision of varied planting and natural materials, introducing appropriate water features, ponds, ducks and birds and importantly, eliminating litter, graffiti and dirt.

One area where tranquil spaces are often lacking is in the healthcare setting, which is ironic given the benefits known to patients from earlier research. Consideration could be given to appropriate wall art internally, to the views out from windows and to treatment of external rest areas for patients or visitors. It is important that both the visual environment and soundscape are complementary. The point was illustrated by slides showing examples of poor and good spaces.

The meeting concluded with questions and answers on a very interesting topic. Thanks to Greg for the presentation and to BDP for their hospitality.

Recent and not so recent developments in sound measurement instrumentation

By John Shelton AcSoft and Svantek UK

Introduction

The 40th anniversary of the IOA is as good a time as any to review what has happened in the instrumentation market over the same period, and in particular, to the humble sound level meter.

This article reviews the basic architecture, and looks at how things have changed, often on the back of consumer electronics, and gives some pointers of where we are headed in the future.

The sound level meter

The basic layout of the sound level meter has not really changed over the years – we're simply trying to make an objective and traceable measurement of the noise level, to allow us to assess environmental noise impact or potential damage to workers' hearing, for example.

The building blocks of our meter are shown in Figure 1.

The starting point is of course the microphone, which transduces the acoustic pressure variation into a voltage analogue, which we can feed into our electronic circuits. Typically, we use a condenser type microphone, for its stability, linearity and ease of calibration. We need to polarise the capacitor, typically with 200 volts DC, and match its inconveniently high output impedance into something we can drive down the line. This requires specialised circuitry, taking the form of a dedicated conditioning preamplifier which normally sits just behind the microphone – the familiar silver tube.

Now we have a signal to work with, and two types of 'detector' are commonly used to make a measurement of sound pressure level. P16

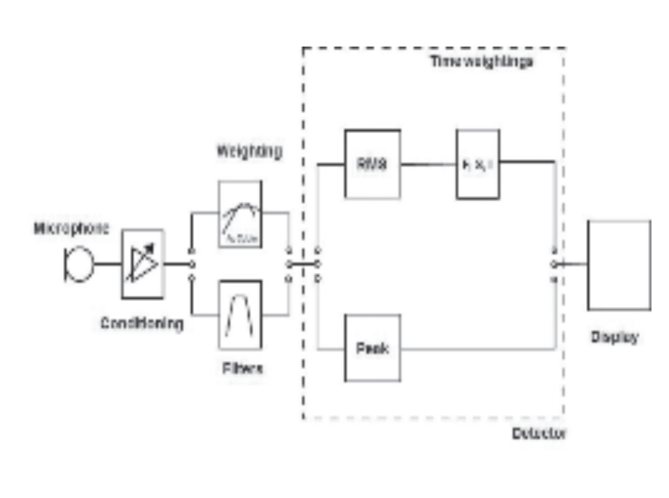


Figure 1

◀P15 The root mean square or RMS detector does what it says on the tin – backwards! Firstly, the waveform is squared, making all the negative excursions positive, then this is averaged to estimate the power in the signal, and finally the square root is taken to get back to a number which is related to a pressure *level*. The output of an RMS detector will fluctuate as much as the input signal, so in order for us to conveniently read the level on a meter, we need to 'damp down' these fluctuations, so a time constant is applied, the choice of which will depend on how much variation there is. We are of course familiar with the old standardised time weightings Fast, Slow and Impulse (more recently updated to just 'F' and 'S').

The Peak detector simply measures the maximum excursion of the acoustic signal (either positive or negative) and this might be useful for estimating damage potential from the noise, such as from blasting or gun shots. The peak detector will normally be used with a hold circuit to make the level readable.

The output of our detectors will be fed to a display, and traditionally, this was a high quality moving coil dial, which even did the decibel conversion to give a readout directly.

If we wanted to assess the noise level and not just the sound level, then there would also be frequency weighting circuits prior to the detector, A and C being the most popular, and for analysis of the frequency makeup of the signal, there may also be some filters, 1/1 octave or 1/3 octave being the most common.

Finally, statistical analysis of the fluctuations of the noise was starting to become interesting, for assessment of notional background noise level for example, and this was achieved, typically in the laboratory, by a fantastic array of equipment attached to the output of the sound level meter. Again, all realised in the analogue world (see Figure 2)

Forty years ago, all this was achieved with high quality analog circuitry from microphone right through to the display. The classic example of this was the B & K Type 2203, which was the weapon of choice for the serious noise warrior. Built in a hernia-inducing case, with all of the elements of our circuit realised with analogue switching, it remains today a great educational tool to understand the science of sound measurement.

The march of digitisation

No-one today could have overlooked the fact that everything is going or has gone 'digital'. The sound level meter was no different, and the process started at the back end of the chain – the display. By sampling the output of the detector, albeit at the slow sample rates (~1Hz) available at that time, the values could be displayed with greater precision on a digital display, to the nearest 0.1dB, and the limited dynamic range of the A/D converters could be improved by doing the log conversion in the detector before sampling.

Of course, the accuracy of the meter did not improve, but 0.1dB resolution was a lot more impressive! Some meters even combined analog and digital displays, such as the rare B&K 2210 (Figure 3).

The next step was to sample the detector output at a higher rate, which allowed some basic mathematics to be done, for example calculating the average value of the signal over a time period. At this time, the idea of the equivalent continuous sound pressure level, or Leq, gained a foothold, and this was easily estimated by sampling the output of a Fast time-weighted detector. The first 'integrating sound level meters' had been born.

Similarly, the samples could also be used for the statistical analysis, resulting in the breakthrough CEL-393 statistical integrating sound level meter (Figure 4), which swept the board in environmental health markets, despite having the user interface from hell!

However, sampling the output of a time weighted detector was always an estimate of the Leq, and as faster A/D converters with adequate dynamic range became available, the Leq could be calculated from the output of the mean-square detector directly – as we should all now know, 'F' time weighting has nothing to do with Leq.

The new family of digital sound level meters now followed the layout of Figure 5, with the output of the detector being sampled at 256 Hz for example. Note that the statistics were still sampled at a lower rate from the time weighted output, and currently there is still no standardisation of the calculation of statistical indices.

Also at this time, the concept of Short Leq emerged, where the digital detector spat out Leq values over short periods, commonly 125ms or shorter. This was ideal for the new idea of datalogging, where complete measurements could be sampled and stored to memory, for later display and processing on new-fangled computers. In fact, memory in sound level meters is a surprisingly new phenomenon – even in the early nineties, portable devices like Psion Organisers and Epson computers were being used to store sound level meter data!

In general, the weighting networks and filters were still realised as analogue networks – a frequency analysis required stepping through the filters one at a time, and hoping the signal was the same at the end, or even still there!

The trend in SLM development by now had been a slow increase in sampling rate, and dynamic range, and already, digital consumer audio was upon us – the compact disc emerging as early as 1982, with 16bit A/D converters and 44.1kHz sampling rates. The advent of low power digital signal processing suddenly made it realistic to digitise the output of the microphone preamplifier directly, and do the rest in Big Sums. Not an easy task necessarily, as our sound level meter still has to cover the complete range of human perception both in level and frequency, but now we can calculate weighting filters, 1/1 & 1/3 octaves, Leq and statistics completely digitally. The idea of digital dynamic range was no different to the old ways.

This simplifies our sound level meter down to Figure 6. Coupled with vastly increased memory, A/D converter and a DSP, almost anything is possible.

You could be forgiven for thinking that this makes sound level meters really easy to make, and therefore the price should drop dramatically. This is not wholly untrue, but there is still a huge skill in signal processing development, especially for our applications, and engineers who used to dabble in LCR circuit design have largely been replaced by firmware engineers, who still cost money for what is a small market compared to CD players. But price-wise, in the early 80s, an integrating type 1 sound level meter, with no memory, cost around £1,800. Today, a completely digital Class 1 sound level meter (Figure 7) with gigabytes of memory will cost around £1,200. A saving, yes, but not dramatic even allowing for inflation.

Completely digital?

Part of the reason sound level meters are relatively expensive, apart from the size of the market and development costs, is the microphone – the last analog bastion in the measurement chain.

Since precision sound level measurements began, the condenser microphone (Figure 8) has been the gold standard, the ½" capsule providing the best compromise in dynamic range and frequency range. Manufactured by a select few companies, the price of such capsules can be anywhere from £400 to over £1,000, a large chunk of the sound level meter budget.

However, for other much larger markets, such as hearing aids, telephones etc, a digital revolution has been happening in microphone development. The use of MEMS (micro electro mechanical systems) or micro-machined silicon transducers is now well established – the mobile phone in your pocket probably has not one, but several MEMS microphones built-in. These are used also for advanced noise cancellation, to make your phone call that much clearer both ends. P18▶

Figure 2

Figure 3

Figure 4

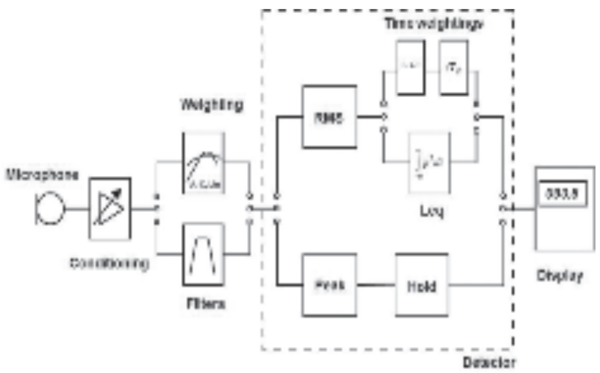


Figure 5

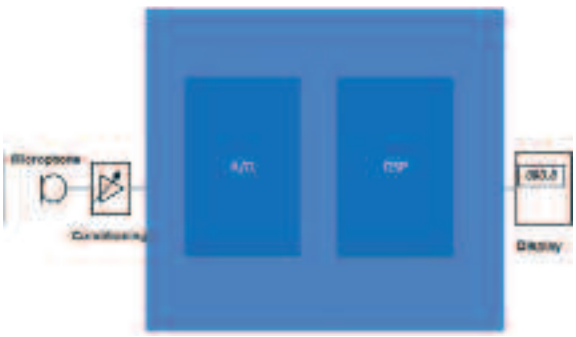


Figure 6

◄P16 MEMS microphones (Figure 9) are still based on the capacitor principle, but the capacitor is machined on to a tiny silicon wafer, which is packaged into a more manageable pot which can be directly soldered onto the circuit board. In some recent cases, the A/D converter can even be built in to the silicon, making what is effectively a digital microphone. MEMS microphones are also incredibly rugged, and of course, the low price of a few dollars is a real advantage.

Can these be used for *measuring* sound? The answer to that lies in the international standards that govern sound level meter performance, and right now, MEMS microphone performance falls short of those requirements. But already, there is a place for them – noise dosemeters (Figure 10) now employ MEMS techniques, as well as specialised techniques such as MIRE for in-ear measurements.

A recent project at NPL proved that a MEMS microphone meeting Class 1 tolerances is possible, so it is only a matter of time for many applications. This will undoubtedly reduce the size and price of sound level meters still further.

Consumer sound level meters?

Another trend in the market, now that everything can be done with an A/D converter and a DSP, is the rise of the App. Using the life support system of the smartphone (which already has MEMS microphones and DSP to burn), software applications are appearing which turn your phone into a sound level meter (Figure 11). Specialised extension microphones are also available to improve the acoustics and performance. Some even claim to meet sound level meter standards. Ironically, a few of these even have 'retro' analogue displays – a real full-circle!

As with PC-based sound level meters 20 years ago, we should still be sure that standards are met, and demonstrably so, so where do these apps fit in? The spectrum analyser apps for example are very good at finding the frequency of an audible tone, but when it comes to measuring the level, this is often only achieved accurately over a limited dynamic range. Also bear in mind that the electromagnetic environment inside a mobile phone is particularly hostile to low level noise measurements.

It's unlikely that Apple, Google, RIM and the like will ever go into the sound level meter market – it's just too small and specialised. Also, producing a new model or operating system every year will obsolete our phone-based instrument too quickly, but the traditional manufacturers can feed off the crumbs left behind – a Class 1 sound level meter with a MEMS microphone is not far off.

Summary

This article has, I hope, given an overview of sound level meter development over the last few decades, highlighting the move from analogue to digital, and consequent increase in value for money. Of course, the same progress applies to vibration meters, spectrum analysers and all manner of sound and vibration instrumentation – 20 years ago, a PC-based spectrum analyser was rocket science – now it's commonplace.

Where will it end? In my view, sound measurements will become even more integrated to the internet – maybe one day our digital MEMS microphone will connect directly to the Cloud, and our noise report will be written before we even get back to the office, along with weather, photos, GPS, maps. Plug your microphone into your Google glasses?

One thing's for sure, the Measurement & Instrumentation Group at the IOA will keep abreast of developments, and make sure the membership is kept informed about best practice!

***John Shelton** has been in the sound & vibration instrumentation business for over 30 years, and this year celebrates 20 years of AcSoft Ltd, pioneers of PC-based instrumentation. A member of the IOA, he is a founder member of the M&I Group and sits on several committees relating to sound & vibration measurement.*

Figure 7

Figure 8

Figure 9

Figure 10

Figure 11

Licensing noise controls in 2014 - the Live Music Act: one strike and you are in!

By Peter Rogers FIOA, Partner of The English Cogger Partnership

Could the picture opposite be a future scene in the beer garden of your local pub? Under the proposed amendments to the Live Music Act 2011 if there are under 500 people there it could happen at least once.

Background

The noise from venues, and their patrons, has long been a problem for local authorities and the residents living near them over the years. The challenge for acousticians in their dealings is what test should be applied for regular, live, entertainment. This is a conflict created by society, where tolerance and balance are required to achieve a workable result

In the past music noise was generally treated simply as another source of noise, which Environmental Health could investigate for statutory nuisance, under Section 79 of the Environmental Protection Act 1990. Inaudibility conditions were commonplace in public entertainment licences across the land and, to some extent, they still are. This is despite being discredited more recently by case law such as the Development Retail Ltd v East Hampshire Magistrates 2011 (known as the Marina Café, Southsea case), in which the inaudibility condition was thought "*so vague as to be unenforceable*". The licensing regime was reformed in 2003 and amplified music became included as a licensable activity in the Licensing Act 2003. One of the act's key licensing objectives is for premises to promote the "*prevention of public nuisance*", as redefined by section 2.19 of the Section 182 Guidance (to be found in full at www.gov.uk). This could include a "*low-level nuisance perhaps affecting a few people living locally*". Whilst this outcome remains unclear, it is generally now supported by case law (The Hope and Glory PH Ltd. v City of Westminster Magistrates' case in 2009), and taken to mean something more than simply a private nuisance, but not necessarily a widely spread disturbance. The remedy, should an objective of the act be breached, is that the local authority carry out a review of the licence, with the ability to add conditions if appropriate, and with the ultimate sanction being its removal.

As a result of the coalition government's desire to go further with deregulation and to cut back on red tape, the Live Music Act was born in 2011. It was championed by the trade, and coincided with the desire to bring live music back into small venues (like pubs) to provide a much needed boost during austere times. The Live Music Act amends Schedule 1 of the Licensing Act by adding paragraphs 12A to 12C, which provide licensed venues and work-places with an exemption from amplified and unamplified live music being classified as a licensable activity under certain circumstances, and any relevant conditions that may be attached to the licence are suspended.

This article looks at the details being proposed for upcoming amendment to the Live Music Act in 2014 and the problems that this may bring residents, acousticians and local authority environ-mental health departments in the year ahead.

The Live Music Act 2011

These are the summarised current circumstances which must apply to qualify for exemption to Schedule 1 of the Licensing Act 2003:

- The live music is unamplified and takes place between 8am and 11pm.
- The live music is amplified but takes place in an audience of no more than 200 people between 8am and 11pm.

Providing venues keep their nose clean and keep track of the opening times and attendance numbers, they will therefore be permitted to continue unrestrained by conditions, unless a review is called for by either the police, residents or local authority officers. If the review is upheld and it is shown that the Licensing Act objectives have not been satisfied (i.e. the prevention of public nuisance has not been promoted) then the venue will lose its exemptions and any pre-existing conditions will again apply. This is what I call the one strike and you are into the Licensing Act.

Coming to a pub near you soon?

A useful summary of the some of the other key points for the current requirements can be found on the Institute of Licensing website [www.instituteoflicensing.org].

Whilst sceptics might reasonably expect that the act would likely result in a rocketing number of instances when reviews are called, this has not yet happened. This may be because local authorities are keeping quiet about the option available to venues, or simply that smaller venues have not yet discovered it. Perhaps the venues might not conceivably want to take the risk with their licence. Only time will tell, as the first Live Music Act reviews are beginning to emerge.

This does not affect the array of other regulatory tools to control noise, which include:

- Environmental Protection Act 1990 – covering statutory nuisance
- Noise and Statutory Nuisance Act 1992 – dealing with statutory noise nuisance in the street
- Noise Act 1996 (amended 2003) – defining excessive music noise from licensed premises
- Anti-Social Behaviour Act 2003 (Part 6) – public nuisance dealt by closure orders.

Proposed Live Music Act changes 2014

The government department responsible (DCMS) has consulted on amending the Live Music Act, with 1,350 responses received. The consultation closed in August 2013. As a result, the following deregulation changes are considered likely to emerge when they are expected to be announced in April 2014, and in summary are thought likely by solicitors involved in the authoring to include the following:

- Live amplified music for an audience up to 500 people in licensed premises and workplaces (including in gardens within the red line of the premises plans)
- Permitted hours for live amplified music remain unchanged at between 8am and 11pm
- Recorded music exemption for audience up to 500 people where that music is a focal point of the entertainment (i.e. performing DJs)
- Unamplified music between the above times. P20

P19 It is only the conditions relating to either live music or recorded music that will be suspended, and not ones that might mention doors or windows being closed, unless it can specifically be linked to live or recorded music.

Paragraph 15.22 of the supporting guidance encourages local authorities to remove conditions that relate to these exceptions, unless sufficiently serious or specific concerns remain. Therefore there is an opportunity to wash away any previous conditions that are outdated (i.e. inaudibility conditions) and provide venues with a fresh start. This clearly will apply to many licences and venues, and a wave of variations applications might result.

The challenges of the changes and current regimes looking to the future

The proposed changes raise a number of issues for acousticians to be aware of, including:

- The Live Music Act may encourage more venues to hold events that might not be suited to them in the first instance, running risks of an increase in number of reviews and also nuisance cases just at the time when many local authorities are experiencing a resource crunch
- Places a potential burden of the tolerance of residents, reliant on reactive measures to resolve problems that would not have otherwise been permitted to occur in the first place.
- This approach does not consider residents well-being, but is aimed at only avoiding the problem becoming so widespread as to be a public nuisance under the Licensing Act. There is a risk then of further erosion of quality of life, rather than its protection and a worsening reputation for licensed premises in society.
- Venues that are not licensed under the Licensing Act 2003 cannot be called to review as a sanction, and enforcement action will be needed to deal with incidents.
- The Noise Act has been hardly used, but does apply as a remedy and test for what is "excessive noise". It is worth using this as an upper benchmark in assessments.

For acousticians it may be time to rethink how we can help define this test through use of objective measures as part of the process; but also better integrated approaches from the outset for designing vibrant areas that work for those using them and living nearby.

Further research is also long overdue to help us get a better understanding on the effects of frequently occurring music noise, what acceptable noise levels might be, and if they could be similar to those for infrequent events. The research done to underpin the Noise Act, commissioned by Defra in 2006, focused on infrequent music events. It is available in the archive of the Defra website in the 2006 section, entitled the Noise from Pubs and Clubs: Phase II.

Acousticians have a role to assist society with this puzzle of how to define thresholds that aim to protect quality of life, as WHO levels are not appropriate to apply in these cases. As people move closer to established venues that are struggling to survive, I can conceivably see beer gardens or car parks that fall within the licensable areas being used as outdoor venues for live music one night only. However, I doubt that residents will tolerate that for long before we see complaints and a review being called. Either way the Live Music Act exceptions leave me expecting plenty of reviews in 2014, and potentially even a Noise Act resurgence.

***Peter Rogers** spent five years within local authority before becoming a consultant. Over the following 15 years there have been many examples of licensing noise management and involvement in defining cases to support his experience. Currently his role as Chairman of the Southern Branch and the newly formed Sustainable Design Task Force means that Peter is keen to work with others in moving intelligent and informed licensing controls around noise forward. An event is planned by the Southern Branch to discuss this topic and review the year in November 2014.*

Poor restaurant acoustics 'recipe for misery' as diners struggle to hear

Poor acoustics are making dining out a misery in many restaurants, according to a new investigation.

More than 80 per cent of respondents to a survey by natural acoustics company The Woolly Shepherd said that on a recent visit to a restaurant the acoustics were so bad they could not hear properly. However, 90 per cent said they would return if the acoustics improved.

Director Tim Simmons said: "What is interesting is that although most people chose to leave, complain or not return because of the noise, only 18 per cent actually complained to the management and 20 per cent did not complain at all."

This meant, he said, that large numbers of people were not returning to restaurants because of poor acoustics – and the industry was doing little about it.

The survey, which was carried out with Quiet Mark and the Noise Abatement Society, had responses from more than 4,000 people.

Mr Simmons added: "We regularly receive suggestions from the public as to restaurants where they badly need acoustic absorption. But whenever we call the venue ourselves, they deny they have a problem at all or claim it's not a high priority.

"A full 97 per cent of people surveyed expressed negative feelings such as disappointment, anger and frustration towards the restaurant concerned.

"Unlike a lack of cleanliness or surly service, excessive reverberation is not visible or well understood, so it can go overlooked.

"The current trend away from curtains and carpets and towards hard surfaces that reflect sound is certainly part of the problem.

We also have to realise that our population is ageing and more older people are continuing to eat out."

Poor acoustics can ruin a meal out

John Connell – anti-noise campaigner extraordinaire

By Mike Goldsmith

In his second of two reports looking at the activities of prominent anti-noise nuisance campaigners, Mike Goldsmith focuses on the period from 1945 onwards and in particular the efforts of one man who did so much to change UK government attitudes to the problem of noise

Following the Second World War, organised anti-noise activities were slow to resume. This may be because, at least in the UK and USA, rather more compliant societies had been engendered by the dominance of military authority during the conflict, but whatever the reason there was little complaint, even though there was increasingly plenty to complain about. Perhaps the greatest difference in terms of noise sources before and after the war was the aeroplane. The war had seen enormous increases in numbers of aircraft in many countries, most of which were now lying idle – but not for long. Entrepreneurs saw the opportunity and the era of leisure travel by plane began. A period of rapid growth followed as more and more planes took to the skies. And of course more planes meant more noise.

Numbers of the "air-minded", as they were sometimes called, grew steadily with rising prosperity and noise regulation lagged far behind. By 1958 aircraft noise was an unregulated blight and in the UK, Heathrow airport (then called London airport) was a particular black spot, being situated in a densely populated area. The launch of the first transatlantic jet service in October of that year significantly worsened the situation. Not only did it halve the transit time between New York and London, it doubled the numbers of seats available too. Prices fell, demand boomed and the skies roared.

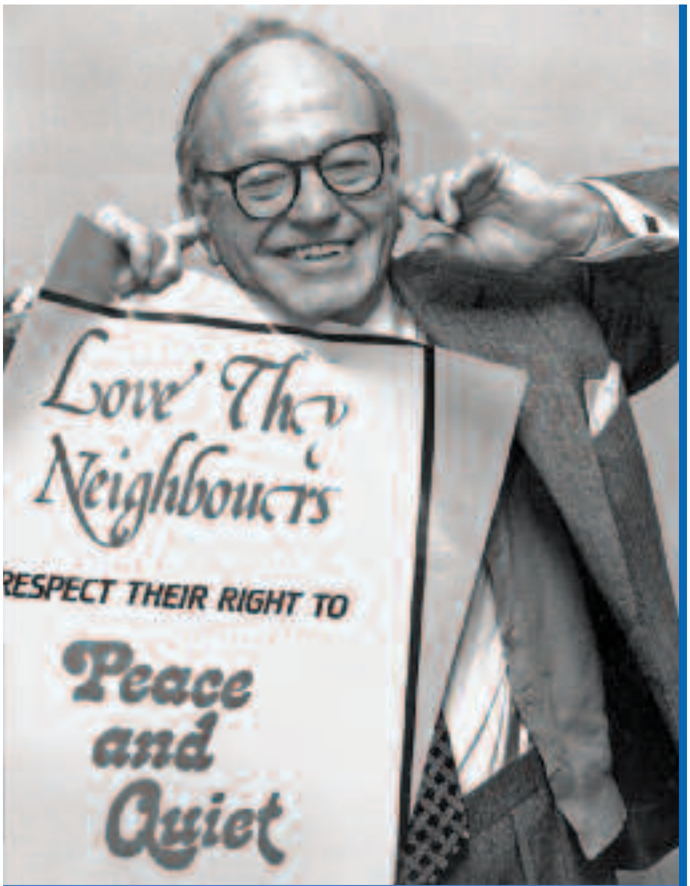
The new "jetliners" were not only larger and more powerful than their predecessors, the noise they made was intrinsically worse too, being pitched closer to peak human hearing sensitivities than that of propeller planes. This sudden worsening in quality of aircraft noise combined with its rapid increase in amount was enough to break the silence of the post-war populations of the USA and the UK alike.

However, in the UK at that time, it was not obvious to whom one should complain about noise: most unfortunately, the Noise Abatement League had closed due to lack of funding just a few years earlier. Consequently, many people whose lives were blighted by aircraft noise adopted the traditional method of venting spleen, by writing letters to the papers. As the summer of 1959 got hotter, aircraft flew lower, and more windows were opened, the number of these letters grew, and one reader decided to do something to help.

London businessman John Connell lost no time in setting up a new organisation to replace the defunct League, and the first action of the Noise Abatement Society was to gauge the problem. Connell placed notices in several newspapers asking anyone concerned about noise to write to him. He received more than 3,000 replies, and launched the Society on its first campaign as a result.

1959 was an election year, so Connell wrote to the parliamentary candidates (all 1,564 of them), asking them to support new anti-noise legislation. All but three did, leading directly to the passing of the *Noise Abatement Act* the following year, which defined noise as a statutory nuisance.

Connell was clear just how vital it was to interest the media in his mission, and his next action was an excellent example. As Minister for Aviation, Duncan Sandys (later Baron Duncan-Sandys)



John Connell launches another campaign

had recently permitted night flights from Heathrow. On behalf of all the people now being woken at unearthly hours, Connell turned up on Sandys' doorsteps at just such a time: 2am, armed with a sound level meter and accompanied by the Press. As a result, the pyjama-clad Sandys was briefly infamous, and so was his decidedly unhelpful response: that noise was an inescapable fact of modern life. Presumably to avoid further bad publicity, government minds changed rapidly and night flights were shortly banned.

Like anti-noise campaigner Julia Rice in the US in the early part of the 20th century, Connell's successes against his first targets encouraged him to broaden his attack on noise and he went on to score several other victories, in particular by encouraging the replacement of metal milk-crates and dustbin-lids by plastic and rubber versions. Consequently, many thousands of citizens were at last able to sleep through early morning deliveries of milk (then almost ubiquitous) and collections of rubbish. His approach in such cases was simple: having come up with a good idea, persist. As he said in 1967,"Authorities take the line of least resistance. If complaints are incessant they will usually rouse themselves out of their torpor and do something about it[1]". Connell became something of a celebrity, frequently appearing on the radio, where he was often introduced as "the noise man[2]", (perhaps it's no coincidence that John Logie Baird was frequently being referred to as "the television man" at about this time).

Thanks in no small part to the work of Connell and the Society, the government became convinced of the seriousness of the noise problem and set up the Wilson Committee to carry out a thoroughgoing investigation. The Committee's report, published in 1963, was a landmark in terms of scope, quality and influence. And the Noise Abatement Society still thrives today, still practising one of Connell's key guidelines: don't tell people what not to do, help them to do it quieter.

The campaigns of Charles Babbage, Julia Rice (see *Acoustics Bulletin* September-October 2013) and John Connell were all aided by the wide-ranging skills, determination, and hard work of their proponents, and they shared other approaches too. All recognised the importance of objective measurement of the problem, all fought for the passing of clear and powerful anti-noise laws and all formed societies or engaged groups of influential supporters. And, crucially perhaps, they were all happy to act as figureheads for their cause: Babbage's image was often to be seen in the pages of *Punch*, Rice travelled widely to publicise her work, and Connell appeared in several Noise Abatement Society posters. This last factor is perhaps the one most lacking in noise campaigns today: what is needed is a recognisable figure, someone identified as knowledgeable, trustworthy and understandable. In the 21st century, such figures are key, especially since it is no longer adequate to caption someone "government expert" or "eminent scientist" if an important message is to be given – neither trust nor interest will automatically follow. What both media and its increasingly glancing audiences want is someone who is persuasive, recognisable, and entertaining too: a noise pioneer for the 21st century.

__Dr Mike Goldsmith__ is a science writer and freelance acoustician; his history of noise, Discord, is published by Oxford University Press.

References

1. *The Catholic Herald*, 25th August 1967, page 2.
2. James Elliott, Noise Abatement Society, personal communication, 15th March 2013.

Community views embedded in noise maps

Researchers in Greece have added a new dimension to noise level mapping by including data on residents' perception and value of different sounds. This consideration of the experiences of residents in this way could lead to more effective policy implementation.

This study focuses on the medium-sized cities of Volos and Larissa in central Greece. To supplement the existing noise level maps, the researchers interviewed approximately 15% of residents in five districts to understand their personal perceptions of noise levels and how sounds affect the character of their area.

From this data, researchers produced maps of the different types of perceived sounds (e.g. traffic, children playing, barking dogs, church bells) with an indication of their perceived level and whether they were judged to be pleasant or unpleasant. They also produced a sound identity map, colour coding the different sound character of the districts, for example, harbour-side, natural, intense city or village-like.

These three types of map, in turn, provided different forms of action plan for noise management. Plans for managing the actual measured noise levels included actions such as erecting noise barriers and reducing or diverting traffic. For example, in three districts near a ring road, noise barriers, combined with roundabouts to slow the traffic and improvements in public transport, were proposed. In central districts, plans suggested building traffic islets, roundabouts and bicycle lanes.

Plans for residents' experience involved managing activities in the district to enable a more positive experience and to P24

◂P23 address sounds considered aggravating, for example, by dealing quickly with noise complaints. Such plans also proposed establishing playgrounds, vegetation, bicycle tracks and leisure centres in outer districts; while in inner city districts, cultural events, shopping activities and green spaces were proposed.

Plans based on sound identity maps aimed to enhance sounds that contributed to the perceived identity or character of an area, such as improving the clarity of church bells in a village-like area, while diminishing sounds that conflicted with this identity such as traffic. These strategies proposed community gardens, public clocks and sound sculptures (works of art that produce sound) for the outer districts while the inner city would benefit from fountains and promenade paths.

Providing these additional and more subjective dimensions to noise maps and action plans considers the residents' experiences, as well as cultural and aesthetic values. This embeds community consultation within these.

This report is based on one that first appeared in *Science for Environment Policy* published by the European Commission.

Marine pile-driving 'harms marine life'

Offshore wind farm construction noise can displace harbour porpoises, researchers in Germany have found.

Manmade marine noise has been found to have negative effects on some species, such as cetaceans (whales, dolphins, and porpoises), including hearing damage and displacement.

Germany has only one resident cetacean, the harbour porpoise, a species considered particularly vulnerable to disturbance, injury or death from human activity. Marine noise is one of these disturbances, potentially capable of damaging hearing and driving away prey species that harbour porpoises feed upon.

Researchers used a combination of aerial surveys and static acoustic monitoring (SAM), a device which logs harbour porpoise echolocation clicks, to determine the effects of turbine pile-driving noise on the porpoises.

Aerial surveys, in an area of 10,900 km², were conducted before, during and after turbine installation between August 2008 and October 2010. SAM data were collected every three months from 12 sites between August 2008 and November 2011. Aerial surveys revealed major differences in harbour porpoise distribution before and during turbine construction. During construction, the porpoises appeared to be avoiding the area. SAM results agreed with aerial survey results, with significantly fewer porpoises detected within 10 kilometres of the pile-driving activity, particularly during longer construction periods. More porpoises were detected at 25 and 50 kilometres from the construction site during pile-driving activity.

The results show a substantial avoidance reaction to pile-driving, suggesting that noise is, at least, unpleasant for harbour porpoises. However, the researchers are unable to assess the level of harm that may result from noise and displacement, both in terms of physical damage to those animals closest to the pile-driving site, and long-term population effects caused by habitat displacement during construction. They suggest that some noise-blocking technologies, such as "air bubble curtains" and "hydro sound dampers" (curtains made of foam or balloons), could be used to reduce habitat displacement during pile-driving.

The authority responsible for licensing offshore wind farms in the German EEZ (Exclusive Economic Zone), the Federal Maritime and Hydrographic Agency, has set a threshold for pile-driving noise, based on advice given by the Federal Environmental Agency.

Each offshore wind farm project is obliged to carry out an environmental impact study, in which the possible effects of noise emissions on the marine environment are described and assessed. Under the conditions of the licence, during the installation of offshore wind turbines, the sound exposure level (SEL) must not exceed 160 dB (re1 mPa) outside a 750 m radius. During noisy work, such as pile-driving, regular measurements of waterborne sound have to be taken.

As EU countries increasingly invest in renewable energy resources, these results may be important for discussions of regulations and policies concerning the construction of offshore wind farms. Following the 2011 Fukushima nuclear power plant catastrophe, Germany increased its focus on renewable energies further, with planned expansion of offshore wind power to provide up to 25GW by 2030. Denmark, the Netherlands, Belgium and the UK also have a large number of offshore wind farms planned or already in operation.

This report is based on one that first appeared in *Science for Environment Policy* published by the European Commission.

Porpoises can be affected by offshore wind farm construction

Back to the future – part 1

By Stuart Dryden FIOA of Rupert Taylor

This technical contribution is an expanded version of a presentation given at the Royal Society in October 2013 as part of the conference 'The Wilson Report – 50 years on'

Background

In January 2012 Defra commissioned a research project from Rupert Taylor to carry out 'An investigation into the effect of historic noise policy interventions' to cover the period from about 1960. This research formed the first part of Defra's consideration of the implications for noise policy of possible changes in the acoustic environment over the next 50 years[1].

In the brief for the research project Defra proposed eight topics for consideration one of which was aircraft noise. The project's findings on aircraft noise are reported in a separate technical contribution in the Bulletin which places it in the context of a wider consideration of changes in the operating environment for aircraft over the past 50 years.

This paper describes the overall project and reports the findings in respect of the other topics studied. The complete Final Report and the six annexes can be downloaded from the Defra website.

Outline of the research

The aim of this research was to examine the effectiveness of a number of policy measures in reducing the impact of the noise problem that they were intended to address in order to determine what lessons could be learnt for the design and implementation of noise policy in the future.

The project was in three phases. First, the policies proposed by Defra were examined and a review was undertaken of information that could be used to evaluate their effects; the policies selected for investigation were then evaluated in phase two. In the final phase, as part of the project reporting, conclusions were drawn not only on the effectiveness of the policies, but also on monitoring the effects of policies in the future.

Phase one – policy selection

The Noise Policy Statement for England defines and applies to three categories of noise – environmental noise (i.e. from transport), neighbour noise (i.e. from occupiers of houses and flats), and neighbourhood noise (e.g. from premises used for industrial or leisure purposes).

The policies on the initial list selected by Defra were chosen by considering how widespread and/or severe a problem the noise sources represented were believed to cause and to ensure that examples of measures that addressed all the three categories of noise defined in the NPSE were included. The initial list of policies is shown in Table 1.

To address this range of topics the following project team was assembled: Philip Dunbavin (ANC/Robust Details Ltd), Lisa Lavia (Noise Abatement Society), Howard Price and Kim Willis (Chartered Institute of Environmental Health), Mary Stevens (formerly of EPUK), and Gary Timmins (BRE).

Evidence of the effects of the measures was sought from a wide variety of sources including, Government (Departments, Parliamentary proceedings, inquiries), research bodies (e.g. the Transport Research Laboratory and the Building Research Establishment), and organisations with a particular interest in noise policy and its effects (the Chartered Institute of Environmental Health, the Noise Abatement Society, and Environmental Protection UK).

The acquisition of data that would enable the effect of polices to be determined proved to be particularly difficult for some topics and as a result of the review the following topics were not taken forward to the evaluation phase: PG24 (Planning and Noise), the Noise Insulation Regulations, and the implementation of the Environmental Impact Regulations. Furthermore, the scope of the investigation of Codes of Practice was restricted to considering BS5228 (the code covering construction and demolition sites) as part of a review of the control of construction noise.

It is instructive to consider briefly the reasons for excluding some of these policies.

PPG 24 had a similar scope to Circular 10/73 which it replaced but added more sources of noise including railways, mineral workings, and sport/leisure activities. A topic that became more developed in PPG24 was guidance on noise levels and new housing and this was therefore considered as a focus for this study. To investigate the effectiveness of this aspect of PG24 evidence would be required on conditions imposed on planning consents; data on applications refused on noise grounds either by the local planning authority (LPA), and refused or granted on appeal would also be useful.

The majority of planning applications are determined by the LPA and although the consent and any conditions imposed are in the public domain there is no centralised location or index of planning consents with the corresponding conditions granted by them. DCLG collects and publishes data on the number of permanent dwellings completed annually and also for the number of planning applications for major housing developments received and granted each year. (Note that a major housing development is defined one for more than 10 houses; no further breakdown by the number of dwellings is made).

Appeals are processed by the Planning Inspectorate (PINS) whose annual statistics report includes the numbers of appeals in respect of major housing developments that were received, decided, and allowed. PINS also holds copies of the Decision Letters for planning appeals which will outline the points put by the parties, the Inspector's analysis and assessment, and list any conditions imposed if the appeal was granted. It is possible to search for and download some decision letters from 2000 onwards by application category (e.g. major housing development) but there is no online search facility by topic (e.g. noise). Earlier decision letters are not searchable. P26 ▸

Item in Specification	Basis of Measure	Kind of Noise		
		Environmental	Neighbour	Neighbourhood
(i) increasing stringency of the permissible noise emission limits from aircraft	ICAO Regulations	1		
(ii) increasing stringency of noise emission limits from road vehicles	EC Regulations	1		
(iii) publication of relevant Planning Policy Guidance	PPG24 1996 (Note, too, Cr 10/73)	1		1
(iv) implementation of the Noise Insulation Regulations	NIRs 1975 (Note, too 1973/1988)	1		
(v) publication of relevant Codes of Practice	Under CoPA 1974			1
(vi) relevant changes to the Building Regulations	Part E 1992 and 2004 (+ amendments)		1	
(vii) implementation of the Environmental Impact Regulations	Directive 85/337/EEC	1		1
(viii) implementation of noise control legislation	From Noise Abatement Act to EPA		1	1
	Total per kind	**5**	**2**	**4**

Table 1: Initial list of policy measures

◂P25 Consequently, it was not considered feasible to obtain sufficient data to evaluate the effect of this specific policy measure either on a statistical basis or at a detailed level.

The 'EIA' directive has resulted in many studies of the effects of a range of environmental topics from proposed developments of various kinds, including noise. A 2011 IEMA study reported that 92% of the sample of 100 Environmental Statements (ESs) from 2010 reviewed for that study included a chapter on noise. The noise topic was 'joint first' with ecology whereas air quality (79%) was in eighth position. Thus, there is the potential for the 'EIA' policy to have had a major effect on noise from developments within its ambit. However, although there are important collections of ESs (e.g. at IEMA and at some universities) there is no central record of them. Moreover, applications for development that require an ES can be granted by the LPA and so do not inevitably lead to an appeal and reference to PINS. Thus much the same problems as regards the availability of data for research apply to this topic as those outlined above in relation to planning in general.

This phase showed that the collection and retention of noise-related data over the 50-year period of the study was highly variable and even systems specifically set up to collect data to assist in the assessment of policy was incomplete. Consequently one of the main challenges of the project was to identify data collected for other purposes from which information relevant to the study could be deduced or extracted. Thus, even for those topics which were taken forward to the evaluation phase, obtaining suitable data sometimes required somewhat tortuous analysis and resorting to unusual sources of supply as will be explained in the following parts of this contribution.

Phases two and three – evaluation of policy effects and conclusions

Investigation of the five policies selected for this phase[2] yielded quantitative results for aircraft noise, road traffic noise, and building regulations. Although extensive analysis was undertaken on the effects of noise control legislation and the control of construction noise, it was generally not possible to identify quantitative effects for specific policies and only qualitative conclusions could be drawn. The analysis undertaken for each topic (except for aircraft noise which is covered in a separate article) and the conclusions are described below.

Road traffic

Evaluation – road traffic

Question to be answered: Has the reduction in noise emission from road vehicles led to lower roadside noise levels?

During the period studied EC directives have set ever reducing values for the 'pass-by' noise emitted from vehicles; the absolute levels and the successive reductions depend on the kind of vehicle.

However, the overall aim of the directives is to reduce noise from *traffic*, not just *vehicles*, so what is of interest is the effect of those reducing limits on 'roadside' noise levels. It is therefore necessary to consider how the policy affects noise from a stream of traffic. A stream of traffic consists of a flow of vehicles of different kinds each of which contributes to the overall noise level at the roadside. If the noise contribution of each type of vehicle is known they can be combined to determine the overall noise level from the stream. The first step is therefore to classify the traffic into different types of vehicle for which the noise emissions can be determined. To determine the noise emission of a specific type of vehicle it is then necessary to determine the flow (e.g. vehicles per hour) for that vehicle category and to have a method for predicting the noise level based on the flow and adjusting the noise level to take account of the changes in the noise limit for that type of vehicle.

In England the standard method for calculating the noise level from a stream of traffic (CRTN[3]) uses only two vehicle categories and does not provide a means for adjusting the noise level to take account of the reductions in the EC limits for individual vehicle types. Since CRTN was not suitable the calculation method adopted was based on that set out in the 1978 Noise Advisory Council (NAC) Report 'A Guide to Measurement and Prediction of the Equivalent ▸

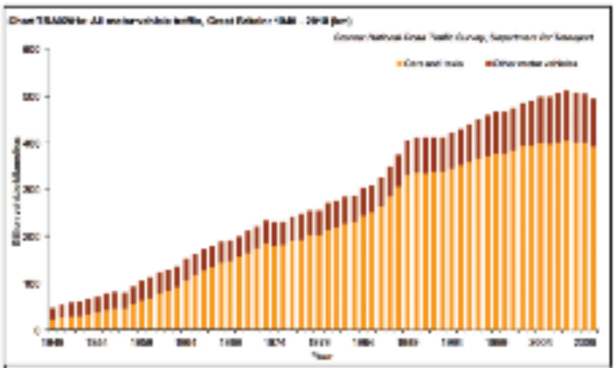


Figure 1 Annual distance for all motor traffic (billion vehicle kilometres) (Department for Transport data.)

Figure 2 Weighted Noise Level and specified EC limit for cars – dB

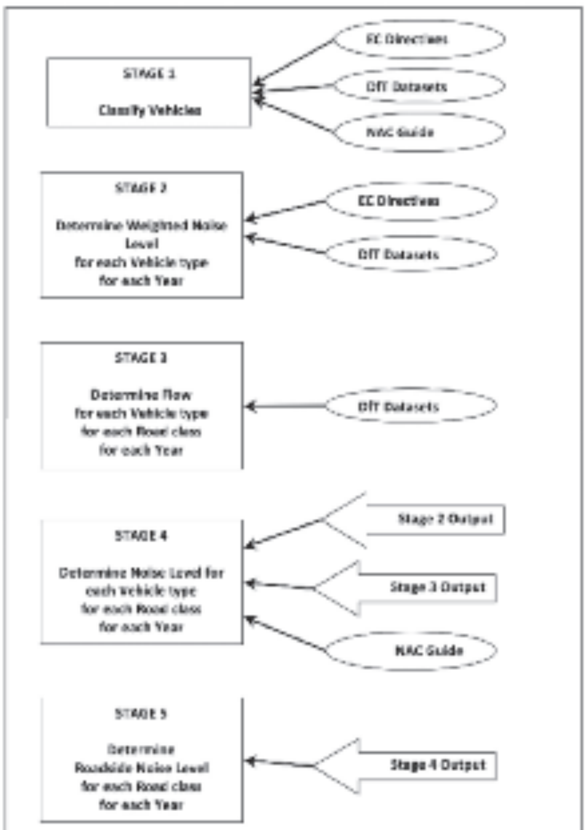


Figure 3 Flow chart showing main stages and data sources used to determine roadside noise levels

Continuous Sound Level Leq’[4]. The NAC method predicts the ‘single event noise exposure level’ (L_{AX}) for the pass-by of a single vehicle for different types of vehicle and different vehicle speeds. Using this approach, if the number of vehicles of a given type passing per hour is known, the average hourly noise level (L_{Aeq}) the stream produces can be easily calculated.

However, in order to determine the traffic noise from a stream of different vehicle types the kind of road must also be considered because the relative proportion of vehicle types varies e.g. between motorways and B-roads. Fortunately the DfT collects traffic flow/census data which is used to estimate each year the annual number of vehicle miles travelled by different types of vehicle on different classes of road and so, in principle, annual flow data by vehicle type and road class are available (see Figure 1).

Another important factor that needs to be taken into account in determining the ‘roadside’ noise level from a stream of traffic for a specific type of vehicle is that the EC limits are not applied retrospectively. Consequently, in a given year the vehicles in a specific class will be made up of examples that comply with whatever the EC limit was when they were first registered plus vehicles that comply with the limit current for that year. From 1994 the DfT has published annual data on the number of vehicles still registered for each vehicle type and so from that date the ‘age profile’ in each year can be determined and from that a ‘weighted noise level’ can be calculated for the national ’fleet’ for that type of vehicle based on the EC limits that applied in preceding years. For the period before 1994 the age profiles for each type of vehicle derived from the dataset described above were used to estimate the rate of decay of vehicle use (by type) and that was applied to a further DfT dataset of vehicles of each type newly registered which covers each year from 1954. Using that analysis the ‘weighted noise level’ and the EC limits in each year from 1970 to 2010 are shown for cars in Figure 2.

A further matter to be resolved before proceeding to calculate the overall noise levels from the composite traffic streams was to reconcile the vehicle types used by the EC, the DfT and the NAC; this was complicated by the fact that the classifications used by the EC and the DfT had each changed over the study period[5]. After reviewing the classifications three main categories were used for the study:

1. 'Cars' – i.e.four-wheeled vehicles up to 1525 kg (so includes cars and light vans)
2. Light goods vehicles (LGVs) – i.e. goods vehicles over 1525 kg and up to 3.5 t
3. HGVs– i.e. goods vehicles over 3.5 t[6]

The main stages in the above process are illustrated in the flow chart in Figure 3.

Analysis – road traffic

Over the study period the number of vehicle miles travelled per year – and hence the traffic flow – has increased and that is one of several factors that have affected roadside noise levels in practice[7]. Calculations of roadside noise level were therefore carried out for three scenarios; the ‘actual’ situation in which the predicted roadside noise levels resulted from the effects of the policy and the increase in traffic flows, the estimated effect of the ‘policy alone’ – i.e. using the 1970 traffic flows and applying the effects of the policy, and finally the ‘no policy’ case for which the effect of traffic growth was included but noise level were held at the 1970 values.

The above analysis was carried out for three classes of road for the years in which an EC noise limit was set, with the change shown relative to the base year (see Table 2). The results presented in Table 2 use the higher EC limits for HGVs hence the note ‘HGV-Hí in the table. The table also shows that the results are for an ‘Impervious’ road surface; the type of road surface must be specified because that also affects the roadside noise levels. The speeds are the default values from CRTN for each class of road.

In the case of motorways the table shows that the effect of the ‘policy alone’ (i.e. having removed the effect of traffic P28

◂P27 growth) is a fall of 8 dBA. The increase in noise level predicted in the absence of the policy (the 'no policy' line in Table 2) owing to increased traffic is 6 dB (corresponding to a quadrupling of the flow). The estimated overall (net) effect of the policy, shown in the final column, is a fall of 2 dB from 1970 noise levels. Equivalent analysis is shown for A-roads (on which there was less traffic growth than occurred on motorways) and minor roads (on which traffic growth was even lower). In both those cases the overall (net) effect was 5 dB.

The data underlying Table 2 for motorways is plotted in Figure 4. In that figure the 'actual' line is the real-world combination of the policy in operation and increasing traffic flows. The 'policy alone' scenario isolates the effect of the policy itself by determining the noise levels with the policy in operation but the traffic flows fixed at their 1970 values i.e. what the effect would have been if nothing else had changed. The third scenario – 'no policy (1970 Limits)' – is to test the effects of the policy not being in place but the traffic flows increasing, by the amount they did in practice.

Conclusions – road traffic

The above estimates are based on DfT data for the number of vehicles of different categories registered in each year and the mileage covered by vehicles in those categories on different classes of road, together with DfT data on the annual length of road in each class in a given year. There is some uncertainty in the DfT data because over the study period the vehicle taxation classes have changed several times. The DfT has therefore issued data for some past years using later classifications by redistributing vehicles between categories. There has also been a degree of approximation in aligning the vehicle classification systems used by the DfT, the ECU and the NAC.

However, these factors do not affect the principal finding which is that the influence on roadside noise levels of changes to noise limits for individual vehicle types is gradual because it is dependent on newer vehicles replacing older ones and furthermore the overall numbers and mileage of vehicles have increased over time.

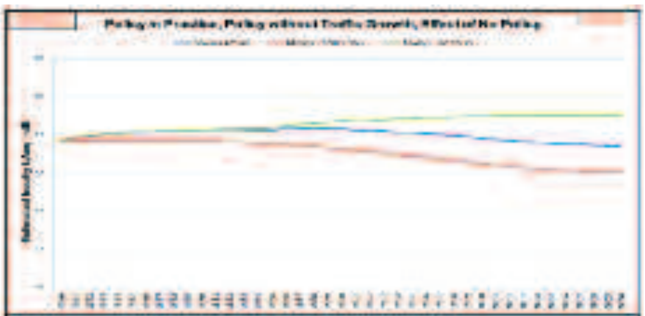


Figure 4 Estimated L_{Aeq} 1-hr 10m from edge of carriageway – dB
Motorways – Cars, LGVs, and HGVs Hi1

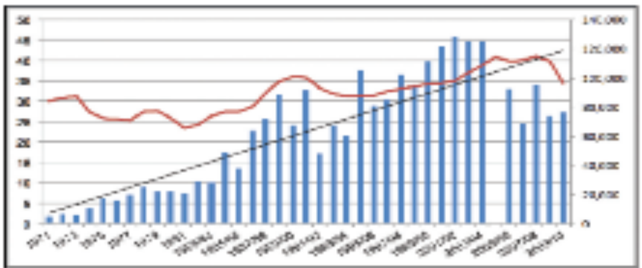


Figure 5 Complaints received for construction noise per responding LA
Volume of Construction Output 1971 – 2010

CIEH LA survey data, left hand scale, and
ONS time series data - £ million, normalised to 2005 prices - right hand scale.

Control of construction noise

Evaluation – control of construction noise

Question to be answered: Did BS 5228 help reduce complaints from construction noise?

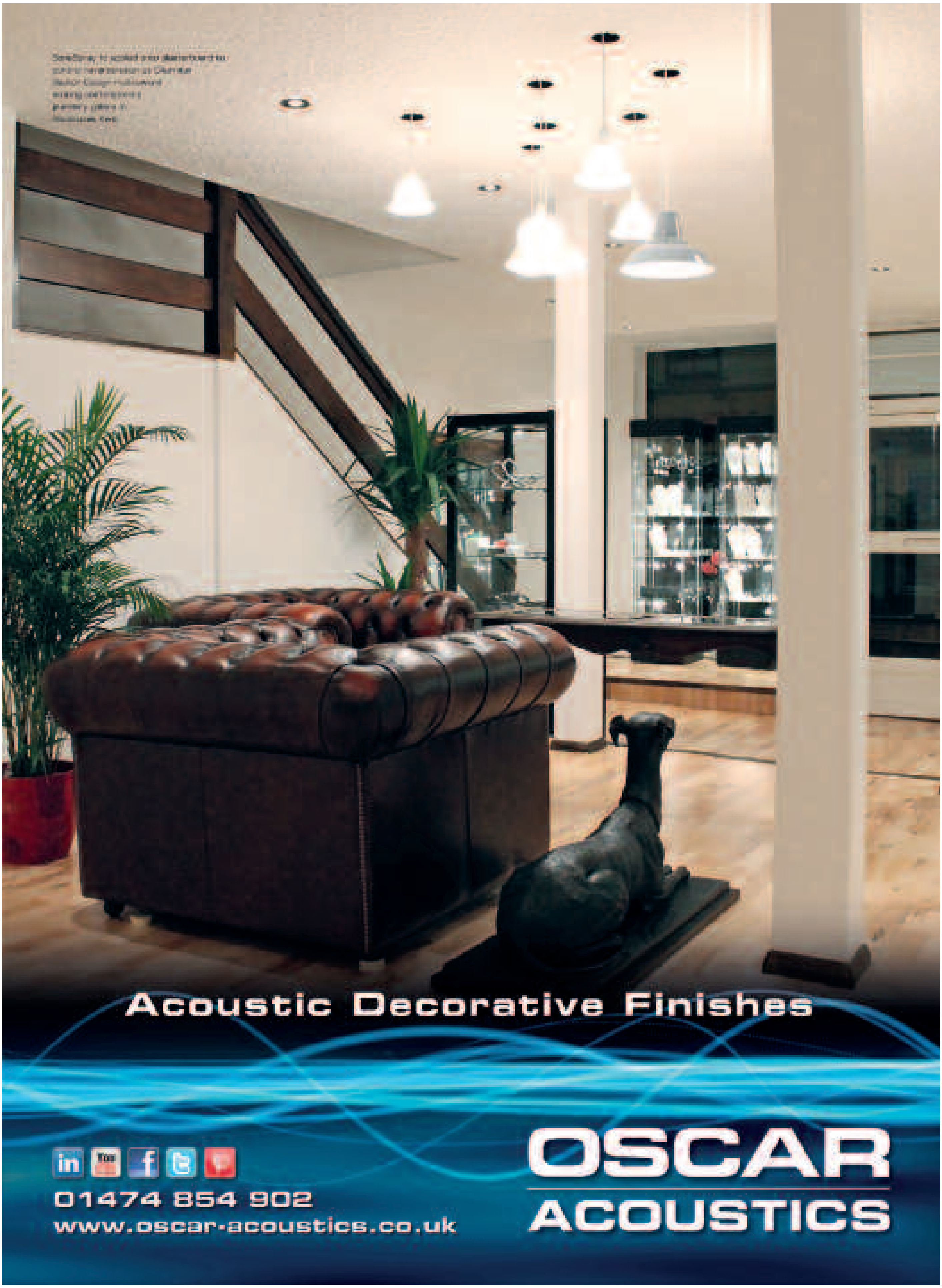
Although the Noise Abatement Act 1960 provided powers for LAs to take action in respect of noise nuisance including that from construction sites it was following the Wilson Committee proposals that a special regime should be provide for this source of noise that the current provisions were devised. The relevant provisions were introduced in the Control of Pollution Act 1974 (CoPA) which enabled the LA to serve a notice to control construction and demolition works (Section 60) and also enable a person intending to carry out construction works to apply to the LA for approval of their proposed working methods and programme (Section 61)[8].

CoPA also introduced power under which the Secretary of State could approve Codes of Practice on particular aspects of noise and in 1975 the British Standards Institute published a Code of Practice on the control of noise from construction and demolition sites (BS5228) which was then approved as a Code of Practice under CoPA[9]. P30▸

Normalised to 1971= 0 dB	*All for Road Surface = Impervious and HGVs Hi1*						
Year >	1971	1982	1989	1996	2002	2010	Overall
Motorways (108 km/h)							**– 2**
Actual	0	+ 2	+ 3	+ 1	– 1	– 2	
Policy alone (1970 flows)	0	0	– 2	– 4	– 7	– 8	
No Policy (1970 Limits)	0	+ 2	+ 4	+ 5	+ 6	+ 6	
A-Roads (80 km/h)							**– 5**
Actual	0	+ 1	0	– 1	– 3	– 5	
Policy alone (1970 flows)	0	0	– 2	– 4	– 6	– 8	
No Policy (1970 Limits)	0	+ 1	+ 2	+ 3	+ 3	+ 3	
Minor Roads (50 km/h)							**– 5**
Actual	0	+ 1	+ 1	– 2	– 4	– 5	
Policy alone (1970 flows)	0	0	– 2	– 4	– 6	– 7	
No Policy (1970 Limits)	0	+ 1	+ 2	+ 2	+ 2	+ 2	

Note 1 Corresponding to the highest EC limit for HGVs

Table 2: Estimated changes in L_{Aeq} 1 hr with and without EC limits – dB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◀ P28
Analysis – control of construction noise
The annual CIEH survey of LAs referred to above (under noise control legislation) has included questions specific to construction noise.

Over the period 1971 to 2008/9 nearly five million complaints and 39,000 notices were served by LAs in respect of construction. Although the CIEH survey is sent to all LAs, the number responding varies from year to year and so these figures do not represent a complete set of data. Furthermore, although notices served by LAs under S60 of CoPA are recorded, there is no similar provision for LA consents under S61.

There are difficulties in analysing complaints to LAs about construction noise owing to the very wide range of construction activities, kinds of plant and relationships with those affected. Despite annual variations, there is a clear long-term downward trend in the proportion of total noise complaints reported to LAs although there is also a clear upward trend in the numbers of complaints about construction noise. This shows that, while complaint numbers increased, they rose more slowly than for other noise sources. Figure 5 shows the annual number of complaints about construction noise and the trend together with the annual Volume of Construction Output in Great Britain for the period 1971 – 2010.

Conclusions – control of construction noise
There has been no fundamental change to the underlying policy provisions since they were introduced and the current implementation of the policy and it seems that practitioners, both LAs and promoters, developed the detail and procedures within the policy framework in response to the need to manage noise from a series of large schemes built in London in the late 1980s/early 1990s. That early experience was then adopted for subsequent major projects in other parts of London and elsewhere.

Computer software which was originally developed to assist with assessments of large road schemes also enabled more sophisticated calculation techniques to be tested and they were subsequently included in later versions of the Code of Practice[10]. The code has also been also updated to provide a noise database for plant and activities for modern equipment working on site rather than data for old equipment or data obtained under test conditions[11].

BS5228 and the procedures set out in S60/61 of CoPA have provided flexibility, and, if used well, have enabled people to be protected.

To be continued

References

1. Defra held a workshop on 'Noise Futures' at the CIEH in March 2013.
2. Aircraft noise, road traffic noise, building regulations, construction noise, and noise control legislation.
3. The Calculation of Road Traffic Noise. DoT 1988. The Design Manual for Roads and Bridges (DoT) includes guidance on implementing CRTN (latest version November 2011, see http://www.dft.gov.uk/ha/standards/dmrb/vol11/section3.htm).
4. HMSO.
5. For example, EC Directives used between 7 and 10 categories covered by between 4 and 5 different noise limits.
6. For HGVs, the EC Directives have used between 2 and 3 subcategories and the range of the noise limits in a given Directive is 2 to 3 dB. Instead of using an average noise limit, two values have been used 'HGV Lo' – corresponding to the lower limit in a given Directive – and 'HGV Hi', corresponding to the highest limit. The analysis was undertaken for both these HGV options.
7. Others include road surface, see Table 2 and the relevant text, and tyre noise. The influence of confounding factors is discussed further in the full report.
8. These provisions sit alongside the 'nuisance' procedures, which can still be used in respect of this source of noise. The current nuisance provisions are contained in the Environmental Protection Act 1990 (as amended).
9. Revisions were issued in 1984, 1986, 1992, 1997, and December 2008; a further revision is in hand.
10. The first such commercially available program in the UK implement BS 5228 was siteNoise (in 1989), now part of the NoiseMap suite, but several other noise mapping softwares now provide a facility to undertake these predictions.
11. This work was undertaken by Hepworth Acoustics for Defra.

Amplitude modulation – where are we now?

By Dick Bowdler

Finally the results of the RenewableUK (RUK) research project into amplitude modulation (AM) of wind turbine noise are out. The project was carried out by a consortium consisting of Hoare Lea Acoustics, the University of Southampton, Robert Davis Associates and the University of Salford. There is still a lot we don't know and a lot further to go before we understand the phenomenon fully but this, together with the work of other researchers, such as Tachibana in Japan and Lee in South Korea, gives us a good basis.

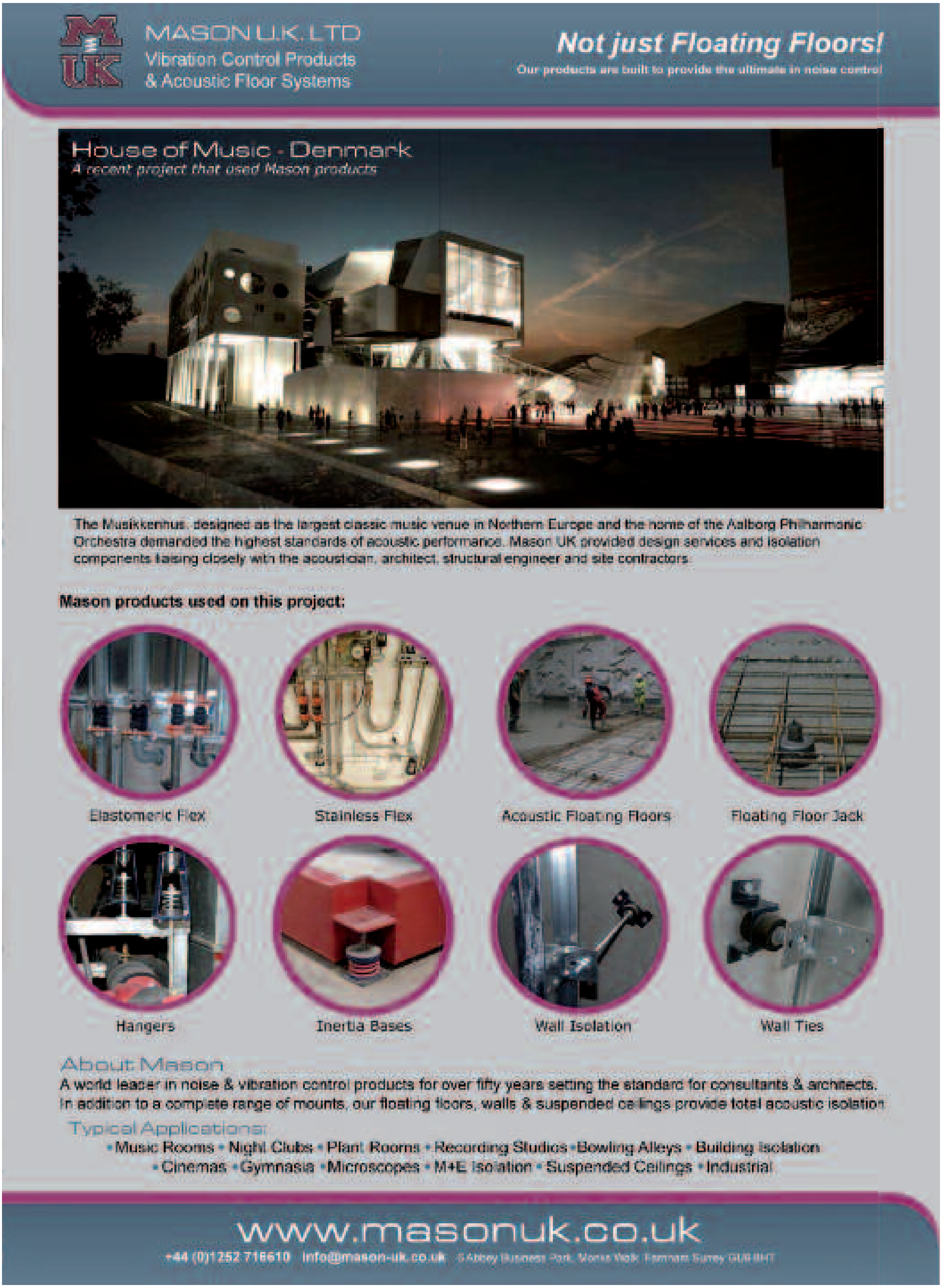
I was part of the project steering group on this project but what I say in this article is my own opinion based on the published research work and on other recent work.

What causes AM?
The normal noise from a turbine is primarily generated at the trailing edge of the blade which has cardioid directivity and which produces the AM commonly called swish which is heard close to a turbine. As we move away downwind and upwind, beyond a certain distance we hear a steady noise without modulation because all the blades round the whole of their rotation are emitting the same noise towards the observer. In the cross wind direction the swish extends over a longer distance because of the directivity of the sound as the blade approaches the observer. But it has been known for some time, for example Di Napoli[1], that AM can be heard clearly downwind at 2km or more and there must be a different mechanism for this. The RUK research calls this "other amplitude modulation" or OAM. I will adopt this though I find it a rather clumsy description.

The blades of a turbine act like an aircraft wing. The forward movement of the blades combined with the wind speed at right angles provides "lift" to the blades. If the pitch of the blades is increased then the angle of attack increases. The angle of attack also increases with increasing wind speed if the pitch angle remains constant. As the angle of attack of the blades increases, the boundary layer of air passing the blades increases in thickness and the noise level moves slightly lower in frequency and increases in level but there is still no AM at any significant distance upwind or downwind.

Eventually, as the angle of attack increases further the blade goes into stall. This produces a lower frequency, higher sound pressure level sound with dipole directivity. If the blades operate in stall round the whole of their trajectory then the sound level downwind increases, in part because of the higher sound power level and in part because of the change in directivity of the sound, but there is still no AM because the blades are emitting the same sound with the same directivity at all parts of the rotation.

On the other hand, if the blades only stall transiently at some point of their trajectory, for example, as they pass through a P32 ▶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Mason products used on this project:
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◀P30 stream of faster air – then there will be a "pulse" of sound with a lower frequency and directed downwind and AM will occur. According to the RUK research, the primary source mechanism for OAM is transient stall of the blades.

One reason why this might happen is because, if blades keep the same pitch angle as they rotate, in high meteorological wind shear conditions where the wind speed at the top of the trajectory is a lot more than that at the bottom, the angle of attack may change sufficiently for the blades to go into transient stall at the top. But this is too simplistic a solution. Both the theoretical analysis and the measurements by RUK show that whilst it is clearly an important factor in some regions, meteorological wind shear is neither necessary nor sufficient for the production of AM on its own. As noted in the report, in one field test the highest level of AM occurred when the wind shear was at its lowest.

The following are all possible contributory factors:

- Vertical variation in wind speed over the rotor disc
- Horizontal variation in wind speed over the rotor disc
- Variation of wind direction over the rotor disc
- Upwind variation in topography
- Upwind obstructions, other turbines or forestry
- Misalignment of the yaw angle
- Blade type
- Blade twist
- Blade pitch control software.

Essentially there are three categories of factors that may increase the chance of AM. Firstly, meteorological, including shear and localised air streams; secondly, obstructions including land, forestry and other turbines and thirdly, features of the construction or the control of the turbines. Whilst we may have a better understanding of the causes of AM, more work is needed to be able to predict it with any certainty.

How can we measure and rate AM?

The important, indeed defining, feature of turbine AM that distinguishes it from other variation of noise is that it is periodic at blade pass frequency (BPF). This means that a methodology that identifies modulation at BPF is crucial to the identifying and rating of AM.

When measuring AM it is important that the measurement metric is the same as that used when carrying out subjective testing. So we first need to define a numerical value to the AM – a "modulation depth" (MD). For example, the difference between LA10 and LA90 will not give the same result as the maximum and minimum levels of a series of 100ms LAeqs. The MD is made difficult to measure because of the continual variation or trend in the overall sound pressure level – for example as can be seen in Figure 1[2]. Some sort of de-trending is therefore necessary to separate the AM from variation of average spl. Lee et Al have used the difference between spl measured on a fast response to that on a slow response as a simple but effective de-trending method.

All these methods produce different values of MD but provided that the same method (or one numerically related) is used for the dose response tests, the results should be the same. The principle adopted by the research team was to use a Fourier Transform based technique to identify automatically the presence of AM from the noise data without having to listen to it or examine a trace. This proved very effective in identifying AM in the field measurements. The procedure of defining the modulation depth in the RUK method is set out in the guidance notes of their model noise condition and they have made the software readily available.

How people respond to AM

The RUK research examined the subjective effect that modulated turbine noise had on people. Tests were carried out on a group of subjects in two ways. The first was to rate AM with different modulation depths and different spls on an absolute annoyance rating. The second was to adjust the level of unmodulated sound to that of the modulated sound so that the annoyance rating was the same.

Early results revealed factors that did not appear to be important in the subjective perception of AM some of which were surprising. For example the frequency content of the sound or the presence of limited amounts of wind induced "masking noise" did not have any significant influence. Perhaps most interesting was the conclusion that the subjective response was not related to the shape of the waveform – that is to say it did not matter whether the sound rose quickly and fell more slowly, or the reverse, rebutting the view that many of us had that one of the problems that AM produced was a "thumping" feature – or a "sharper attack" than normal as it was described in the Salford Report of 2007.

The results show, as might be expected, an increase in annoyance with MD. However, the summary of the findings WPF says that "*This showed that annoyance increases slightly with modulation depth. However, the observed effect is continuous with there being no evidence of a clear onset of increased annoyance at a particular modulation depth, particularly when considering the large spread of ratings. In contrast, the mean overall noise levels were shown to dominate the annoyance rating.*"

We can only speculate on the reason for the apparent low impact of AM in the results which appears to be contrary to commonly reported impact and perhaps to common sense. But we have to remember that the constant factor in each test is the sound level measured as LAeq. If the constant factor were the sound level measured in another parameter such as LA50 then the result would be different. More specifically, in the particular case of LA50, increasing modulation would show a bigger impact than it does with LAeq. We do not know whether people's subjective view of noisiness is more related to LAeq than LA50 – or indeed to some other parameter so some caution needs to be exercised in suggesting what impact increasing MD has. I will return to this point when I look at the AM condition.

The other factor that may confuse the subjective response to AM is that increasing AM appears frequently to be associated with increasing overall spl. Figure 1 shows an example of AM where the trend of the overall sound level, whether measured as LAeq, LA50 or even LA90 broadly follows the degree of modulation depth.

The AM condition

As far as applying a penalty for AM in a noise condition, or P34▶

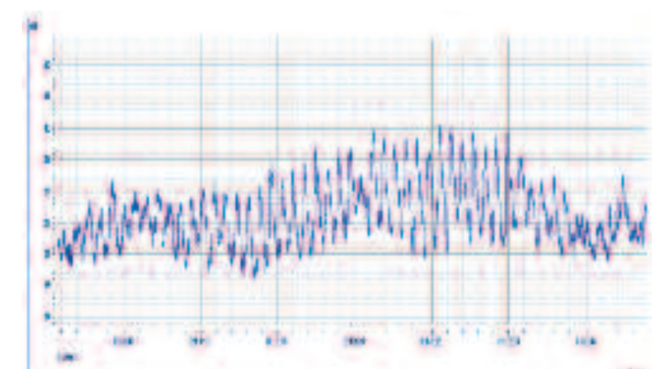
Figure 1

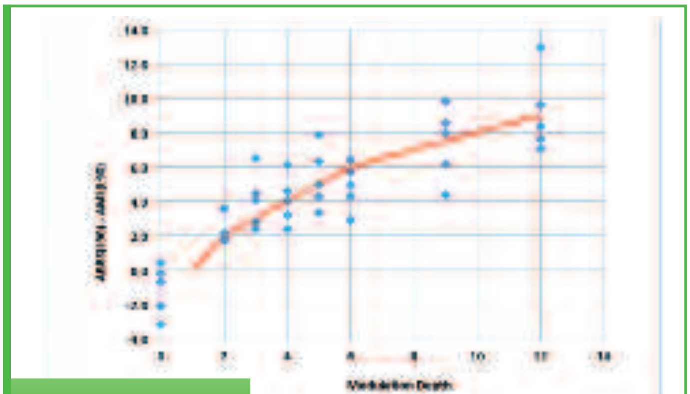
Figure 2

◂P32 establishing a cut-off point at which AM is simply not acceptable, what does the research tell us? First, should it be a stand-alone condition or a penalty to the sound pressure level in the same way as tones. My preference is for a penalty because that seems to relate best to annoyance (the level and the MD are interlinked). It has been suggested that a penalty is not appropriate because a 5dB penalty at night on a spl of 38dB would still not breach the 43dB night time limit. However, this is because the night time limit is too high, not because a penalty does not work.

An argument is set out in the RUK model condition published with the research papers. There are two flaws with this argument where it seeks to establish a penalty. The first is that no correction has been made for the difference between the metric used for measuring AM in WPB1 and the metric used for assessing annoyance in WPB2. This requires that an average of around 1dB needs to be added to the figures. The second is that the penalty system used is related to Leq whereas in the UK we use LA90 and so that should be the reference to which the penalty is added. If we apply these corrections we can draw a penalty for AM of the same kind as in the RUK model planning condition. This is shown in Figure 2. This starts off in a broadly similar manner with a 3dB penalty at MD=3 but then rises faster than the RUK graph.

Appendix 22 of WPB2 on p260 shows a comparison of the results in terms of LAeq and LA90. Perhaps the most striking difference between the two parameters is in Fig 22.2 which shows a flattening off of annoyance with increasing modulation depth when LAeq is used but a continuing increase in annoyance when LA90 is used. This can be explained by the fact that, as modulation increases, the difference between LAeq and LA90 also increases.

Leaving aside the Swinford style AM condition, we now have two AM planning conditions. The RUK condition has the advantage over Mike Stigwood's Den Brook condition in that it was evidence based. However, they both fail properly to address the issue of intermittency. That is to say how do you distinguish between similar levels of AM that occur eight hours on one night a month, every night for an hour or for 10 minutes once a year?

The question of intermittency needs to be addressed because excess AM occurring for an hour a month is clearly not as significant as the same level every night for eight hours. Though neither methodology addresses the issue each one in effect allows for it. The Den Brook condition is triggered by a single failure of the test which could in theory (though unlikely) be triggered by an aggregate of 30 seconds of amplitude modulation in any one hour, even if just once. On the other hand, the RUK condition averages out the AM over an undefined period of time in such a way that it might be that the AM is reduced to insignificance. Neither of these solutions is satisfactory. First of all, a judgement has to be made as to how to treat intermittency – because this is the one area where we do not have an evidence base. Then we need to adapt the condition.

The notch

Like all research, it has opened up a number of intriguing puzzles. Why is there sometimes a notch in the peak of the signal? It has been suggested that it is two turbines just out of phase. That seems unlikely because it occurs with a single turbine and also because it might be expected to widen into two peaks or disappear as the phasing changes. Another suggestion is that it is the shadowing effect of the tower as the blade passes. That also seems to be unlikely because it means that the peak of the AM is at the bottom of the blade trajectory which is the least likely place for it to be. Such notches also appear close to the turbine in swish AM as can be seen in Lee et Al

Conclusion

The RUK research and other research in the last two or three years has given us a much better insight into the causes and the analysis of amplitude modulation from turbines. We are still some way off from being able to predict it though and, as it appears to become more common, more work is needed to devise a fair noise condition that protects people whilst still allowing the development of wind farms.

References

1. Long Distance Amplitude Modulation of Wind Turbine Noise. Carlo di Napoli. Fourth International Meeting on Wind Turbine Noise 2011.
2. C. Di Napoli, Long distance Amplitude Modulation of Wind Turbine Noise:, proc. 4th Int. Meeting on Wind Turbine Noise, Rome, 2011
3. Annoyance caused by amplitude modulation of wind turbine noise. Lee et al. Noise Control Eng J. 59 (1) Jan-Feb 2011.

Estimation of uncertainty using revised draft ISO 1996-2

By Sonia Alves of MBBM, Munich and David Waddington of the University of Salford

Abstract

The aim of this paper is to examine methods for the estimation of the uncertainty associated with environmental acoustic measurements. It is considered best practice that any measurement should be accompanied by a quantitative indication of its quality, that is, the uncertainty of the measurement. ISO 1996-2:2007 "Acoustics - Description, measurement and assessment of environmental noise - Part 2: Determination of environmental noise levels" presents guidelines on how to determine the measurement uncertainty associated with environmental acoustic measurements, although the presentation of this value is not yet mandatory. However, this international standard is to be revised (stage 90.92 at 17 June 2012). From discussion with members of the ISO Standard working group, the last working draft ISO 1996-2:2011(11-02-02 2nd working draft) follows the uncertainty calculation methodology recommended in IMAGINE documents and it states that the estimation of measurement uncertainty should be reported. This paper presents a method, based on the ISO working document, to perform this calculation as well as two worked examples (road traffic noise and railway traffic noise). In concluding, this paper presents a reflection on why an estimate of the uncertainty of the measurement is essential in environmental acoustics, comments on the approach currently being followed by the main European and International standards, and finally summarises methods to minimise the uncertainty associated with environmental noise level measurements.

[This article contains work previously presented at the VIII Congresso Ibero-americano de Acústica: Acústica 2012.]

Introduction

When performing a measurement and reporting its result, a quantitative indication of the quality of that measurement should be presented. Not only does this indication allow the user to decide if the result is reliable for the purpose, but it also permits the measurement result to be evaluated by others or compared with reference values [1]. This has been the theme for several ▸

discussions on environmental noise measurements and there is still no consensus on the method for the estimation of uncertainty of such measurements. It is still not common to find a result of an environmental noise measurement reported with the uncertainty estimation for that measurement.

The European directive 2002/49/EC establishes the common noise indicators Lden and Lnight to be used by European countries to identify noise levels and to be used when taking protection measurements against noise. The IMAGINE project has developed several guideline documents on how to measure and/or calculate those parameters, establishing a common methodology. One of those documents [3] establishes a methodology for the measurement of the Lden and Ln parameters, and presents guidance on how to evaluate the uncertainty of an environmental noise measurement.

This IMAGINE document was one of the inspirations for the latest revision of ISO 1996-2: 2007. According to this working draft, one of the items to be reported is the estimation of measurement uncertainty and the estimation method that was used. This could be taken as an indication that the uncertainty estimation will be a factor to be considered when reporting sound pressure levels in accordance with the revised ISO 1996-2.

In this paper, the guidance on uncertainty estimation methods for environmental acoustic measurements presented in the ISO 1996-2 working draft [5] is examined in both theory and practice. This research examines the measurement of road traffic and railway traffic noise. Due to time and budget constraints, only short-term measurements were done. The measurement methods presented in the working draft are followed, with the final result presented with an estimation of measurement uncertainty. The uncertainty estimation method for road traffic noise is also compared with the uncertainty estimation method presented by Craven [6].

Uncertainty estimation

1.1 Establishing an uncertainty budget

Following standardised methods will help to control the variability and impact of these conditions on the measurement result and an uncertainty budget is a necessary step when estimating uncertainties. It consists of identify each separate contribution, making an evaluation of each individual value and combining them according to a set of statistical procedures.

1.2 Uncertainty estimation- general model

The mathematical model that represents the process of uncertainty estimation of a measurement is developed in *GUM - Evaluation of measurement data — Guide to the expression of uncertainty in measurement* [1] and is summarized in this section. Assuming that a measurand Y is going to be determined from N measurements $X_1,X_2,X_3,..,X_N$. This process starts with establishing a mathematical relationship between the N measurements and the measurand. Thus Y will be a function, f, of those quantities

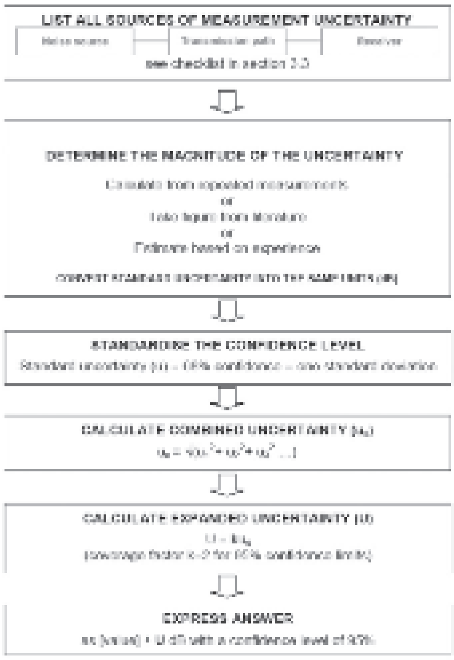

Figure 1- Uncertainty Budget Flowchart in DTI Guide

which can be written as:

$$Y = f(X_1, X_2, X_3, \ldots, X_N) \quad (1)$$

As the values $x_1,x_2,x_3,..,x_n$ are estimates of the input quantities $X_1,X_2,X_3,..,X_n$, as a consequence each estimate, x_i, will have an uncertainty associated, $u(x_i)$, which is expressed as a standard deviation. $u(x_i)$ is the standard measurement uncertainty.

Each uncertainty component will be treated following the same statistical process, whether the uncertainty component is determined through a statistical process or obtained from any other method. All uncertainties will then be combined through a functional relationship that is a linear combination with a sensitivity coefficient, c_i. The functional relationship of the combined uncertainty is "...equal to the positive square root of a sum of terms..." (definition 2.3.4 of [1]).

$$u(y) = \sqrt{\sum (c_i u_i)^2} \quad (2)$$

Where the sensitivity coefficient, c_i is given by:

$$c_i = \frac{\partial f}{\partial x_i} \quad (3)$$

P36

◄P35 The overall uncertainty will be expressed as an expanded uncertainty, U. This quantity will, with a statement of confidence, define an interval where the measurand Y will be. This will be obtained by multiplying the combined standard uncertainty by a numerical factor, known as the coverage factor, k:

$$U = k u_c(y) \quad (4)$$

A coverage factor of 2 is normally used, which corresponds to a coverage probability of 95%. [1]

Considering the previous paragraphs, the concept of a Type-A uncertainty can now be introduced. If the value x_i is estimated from n independent measurements obtained under the same measurement conditions, $x_{i,k}$ then the best estimation of x_i is the arithmetic mean of the n observations and the standard deviation of such uncertainty is given by:

$$\bar{x}_i = \frac{\sum_{k=1}^{n} x_{i,k}}{n} \quad (5)$$

Finally, the standard deviation is given by:

$$s(x_i) = s(\bar{x}_i) = \frac{s(x_i)}{\sqrt{n}} \quad (6)$$

Where $s(x_i)$ is the experimental standard deviation and n the total number of samples. This is the general form of a Type-A standard uncertainty.

All the uncertainties that do not meet these criteria are type B standard uncertainties. This applies when the estimates $x_1, x_2, \ldots x_n$ of the input quantities $X_1, X_2, \ldots, X_N$ are estimated by other means other than a statistical analysis, when dispersion of the values of the measurand is previously known. For example, information given by technical documentation or manuals, research conclusions, values indicated in standards such as in the case of the sound level meters uncertainty components. Reference [1] and [6] should be consulted for a more comprehensive perspective on this subject.

Uncertainties in environmental noise measurement

The big challenge in environmental acoustic measurements is to obtain the expression for Y= f(Xi), as there are so many variables that affect the results, especially in outdoor measurements. The variability is inherent to a sound field both in time and in space, and can be identified:

- At the source: not only the source itself, but also all the other sources that contribute for the environmental sound. For example, in a seaside town, not only the road noise will be higher in summer, due to more traffic, but also the number of people will increase and as a consequence the noise generated by their activities will inevitably be higher;
- In the transmission path: that includes the meteorological effects, terrain topography and vegetation present, that will affect the sound propagation;
- At the receiver: receiver position, the measurement equipment among others.[7]

According to the revised draft ISO1996-2 reference [5], an estimation for equation (1) is given by:

$$L = L' + 10 \lg\left(1 - 10^{-0.1(L' - L_{res})}\right) + \delta_{sou} + \delta_{met} + \delta_{loc} \quad (7)$$

"Where L is the estimated value during the specified conditions for which we want a measured value; L' is the measured value including background noise, L_{res} = residual noise[2], δ_{sou} = an input quantity to allow for any error due to deviations from the ideal operating conditions of the source, δ_{met}= an input quantity to allow for any error due to meteorological conditions deviating from the ideal conditions, δ_{loc}= an input quantity to allow for any error due to the selection of receiver position. Often $\delta_{sou} + \delta_{met}$ is determined directly from measurements. L' and L_{res} are both dependent on δ_{slm} = an input quantity to allow for any error of the measurement chain (sound level meter in the simplest case). In addition L_{res} depends on δ_{res} = an input quantity to allow for any error due to residual noise."

Reference [5] also presents some guidance on how to estimate the sensitivity coefficients, ci and the standard uncertainty, u_i, when measuring A-weighted sound pressure levels. See table 1.

2 Measurements

Two short-term environmental noise measurements (road and railway noise) were performed according to ISO working draft procedures. For more details about receiver location, free-field condition, source operation, transmission path and verification of favourable meteorological conditions, see [14]. For both measurement campaigns the instrumentation met the specifications defined on the working document [5] and was calibrated in accredited laboratories. A calibration procedure was also performed according to the working draft.

2.1 Railway noise measurements

2.1.1 Objectives of the railway measurements

The railway noise was evaluated from SEL (or L_{AE}), included 51 train passages and the short-term parameter was used to obtain a long-term parameter L_{den}, that according to the Directive 2004/49 EC represents a yearly value.

2.1.2 Measurement site description and results

The railway was located at the north of Portugal and had two tracks. It was a zone with a speed limit of 80 Km/h (no braking or acceleration at the specific site). The microphone was placed 7.5 meters from the nearest track, the ground between source and receiver hard and dry. The measurements were done in two different days. As suggested in [5], at least five passages of each train category (high speed, inter-city, regional and freight trains) were recorded. The start and end of each event was the operator's responsibility and were done according to the methodology of the working draft. Meteorological conditions were monitored 15 minutes before starting the measurements and checked every five minutes until the end of the measurements (favourable meteorological conditions were verified).

Measurement results are presented in the tables 2 & 3. P38►

Quantity	Estimate	Standard uncertainty, ui	Magnitude of sensitivity coefficient, c_i
$L' + \delta_{slm}$	L'	u(L') 0,5[a]	$\frac{1}{1-10^{-0,1(L'-L_{res})}}$
δ_{sou}	0	u_{sou}	1
δ_{met}	0	u_{met}	1
δ_{loc}	0,0-6,0	u_{loc}	1
$L_{res} + \delta_{res}$	L_{res}	u_{res}	$\frac{10^{-0,1(L'-L_{res})}}{1-10^{-0,1(L'-L_{res})}}$

a) 0,5 refers to a class 1 sound level meter. A class 2 meter would have the standard uncertainty 1,5 dB

Table 1 – Overview of uncertainties to be determined for a measured value [5]

Train category	Valid Pass-bys
Regional Train	30
Intercity train	8
High speed train	8
Freight train	5
Total (regardless train category)	51

Table 2 – Pass-bys according to category

1. Assuming the measurement process follows a normal distribution. For other types of distribution more references can be found in [1] and [14]
2. In [8] residual sound is defined as the total sound remaining at a given situation when the specific sounds under consideration are suppressed.


01dB

◀ P36
2.1.3 Standard uncertainty associated with the source operation

Reference [5] mentions that the standard uncertainty associated with the source operation, is determined according to equation (8):

$$u_{s,re} = \frac{C}{\sqrt{n}} \quad (8)$$

and for railway traffic noise, C= 10 if the sampling was made regardless the operating conditions and C=5 if the sampling takes into account the relative occurrence of train categories. When comparing equation (7) with equation (5), it can be deducted that C corresponds to the experimental standard deviation of SEL levels. However, the standard also mentions that a more accurate uncertainty can be determined from direct measurements of SEL of individual pass-bys for both conditions. Table 4 examines whether this statement be support by measurements.

2.1.4 Determination of Lden from individual events and determination of the expanded uncertainty

The objective of this measurement was the determination of a long term parameter L_{den}, from individual events. Following the strategy defined in point 10.5.2 and equation (D.18) from reference [5], the objective is to obtain the parameters L_{day}, $L_{evening}$ and L_{night} and L_{den}. The events were stratified into relevant source categories according to the definition previously presented. The next step was to obtain the average of each relevant source category i, $L_{E,i}$ and then calculate the L_{day} for the reference conditions, according to equation:

$$L_{day} = 10\log\left[\sum_{i=1}^{n} N_{ref,i} \cdot 10^{0,1L_{Ei}}\right] - 10\log(T_{ref}) \quad (9)$$

where L_{Ei} is the measured average sound exposure level of trains of category i ; n is the number of train categories identified and $N_{ref,i}$ is the number of trains for each category i passing during the reference time and T_{ref} is the reference time (in seconds as the L_{Ei} is integrated in seconds). See table 5.

The values for L_{day}, $L_{evening}$ and L_{night} can now be calculated to obtain the final value of the yearly L_{den} (definitions according to the standard). See table 6.

The uncertainty budget for the determination of the L_{den} from short-term measurements and calculation is shown in table 7.

2.2 Road traffic noise measurements

2.2.1 Objectives of the road traffic noise measurements

The road noise was evaluated from the parameter $L_{Aeq,1h}$ and the uncertainty calculation performed according to reference [5] and compared with the method of reference [6].

2.2.2 Measurement site description and results

The measurement site for road traffic noise was at a future residential site. It was a dual carriageway and the microphone was placed at two meters, the estimated height of the future ground floor residents. As there was no official information about the road traffic, all information on the traffic was recorded according to requirement of reference [5]: number of passages according to the categories (light, medium heavy, heavy, other vehicles and two-wheelers), each category average velocity and the road conditions. Meteorological conditions were monitored 15 minutes before starting the measurements and checked every five minutes (favourable meteorological conditions were verified).

The results are presented in tables 8 & 9.

2.2.3 Uncertainty calculation of the one-hour $L_{Aeq,1h}$ measurement according to reference [5]

The uncertainty calculation for the road noise measurement followed the example presented in point G2 of reference [5]. See table 10. P40 ▶

	Regional	Inter-City	High Speed	Freight
Average LAE (energetic mean)	84,7	98,5	89,8	102,3
Average LA95 (energetic mean)	57,4	61,9	60,0	65,1

Table 3 – Railway traffic measurement results

		Sample (N)	Experimental Standard deviation s (xi)	Reference C
Regardless train categories		51	7	10
Train Categories	Regional	30	3	5
	Inter-city	8	4	5
	High Speed	8	3	5
	Freight	5	5	5

Table 4 – Comparison of the working draft document for the reference value C and measurement results

	Statistics of the yearly number of trains per period of reference					Trains per hour assuming constant volume of traffic
	Regional	Inter-City	High Speed	Freight	Total	
Day (07:00 – 19:00)	34	11	16	10	71	5,92
Evening (19:00 – 23:00)	8	4	5	4	21	5,25
Night (23:00-07:00)	5	1	1	0	7	0,88

Table 5 – Estimation of the yearly number of trains, based on the timetables of the only operator of passenger trains in Portugal at the time of measurements. The freight trains were estimated based on observation as no data was available.

L_{day} dB(A)	$L_{evening}$ dB(A)	L_{night} dB(A)	L_{den} dB(A)
67,0	66,5	58,7	68,7

Table 6 – Calculation of final results

Photo 1- SLM system

Photo 2- Several measurement systems

Photo 3- High speed train (Alfa train)

Quantity	Estimate (dB(A))	Standard Uncertainty, u_i (dB(A))	Magnitude of sensitivity coefficient, c_i (dB(A))	Uncertainty contribution c_iu_i (dB(A))
L'+ δslm+ δsou	L'	u(L') 0,5 ---	$\frac{1}{1-10^{-0,1(L'-L_{res})}}$	3,29 0,50 ----
δmet	0	umet	1	2,00
δloc	0,0-6,0	uloc	1	0,00
Lres+ δres	Lres	ures	$\frac{10^{-0,1(L'-L_{res})}}{1-10^{-0,1(L'-L_{res})}}$	0,25
U (Lden)				3,89
Expanded uncertainty				7,78
Lden	68.2			

Table 7 – Uncertainty budget for the determination of Lden

Main category	Number of pass-bys
Light vehicles	1514
Medium heavy vehicles	57
Heavy vehicles	30
Other heavy vehicles	5
Two wheelers	16
Total	1622

Table 8 – Number of pass-bys during the one-hour measurement according to category

File N.°	Start time	Duration	L_{Aeq} (dB)	L_{A95} (dB)
001	08:03:56	01:00:00	61,5	51,1

Table 9 – Results of the road traffic noise measurement

Quantity	Estimate (dB(A))	Standard Uncertainty, u_i	Magnitude of sensitivity coefficient, ci	Uncertainty contribution, CiUi
$L'+\delta_{slm}$	L'= 61,5	0,50	1,10	0,55
δ_{sou}	1622 vehicles	0,25[a)]	1,00	0,25
δ_{met}	favourable	2,00	1,00	2,00
δ_{loc}	+0,0 (free-field)	0,00	1,00	0,00
$L_{res}+\delta_{res}$	L_{res} =51,1	2,00	0,22	0,20 [b)]
Combined uncertainty (root sum of squares)				2,10
Expanded Uncertainty (95% confidence [k=2])				4.20
Final result				$L_{Aeq,1hour}$=61,5 dB(A) ± 4,2 dB(A)

a) The standard uncertainty for road noise was determined using equation (8) and considering C=10, for mixed traffic conditions. **b)** Considering observations of Annex F, section 2 (F2) of the ISO 1996-2:2011 (rev1)).

Table 10 – Uncertainty calculation of the one-hour measurement according to reference [5]

Photo 4- Freight train

P38

2.2.4 Uncertainty calculation of the one-hour $L_{Aeq,1h}$ measurement according to (according to DTI Craven [6])

See table 11.

3 Conclusions

3.1 Road traffic

The results from the road traffic noise exercises indicate that the magnitude of the uncertainty associated with a short term measurement of $L_{Aeq,1h}$ calculated using the procedure presented in the ISO 1996-2:2011 working draft [5] was ± 4,2dB with a confidence level of 95%. This shows excellent agreement with the method presented by Craven [6] for which the expanded uncertainty was ± 4,3dB with a confidence level of 95%. In each case the largest source of uncertainty was associated with the effect of meteorology on propagation.

3.2 Railway traffic

For railway traffic noise, the uncertainty for the determination of the Lden from short-term measurements was ± 7,8dB with a confidence level of 95%. In this case the standard uncertainty associated with the source operation was the largest. The results of the railway traffic noise exercises supported the factors for the standard uncertainty associated with the source operation recommended in the ISO 1996-2:2011 working draft, reference document [5].

3.3 Long term measurements

Further work should include long term measurements for comparison. The ISO 1996-2:2011 working draft presents an example of uncertainty estimation for a long term measurement. It was based in 75 efficient 24-hour measurements taken during the stratified periods (day, evening and night) and between four different meteorological classes. The expanded uncertainty associated with that measurement was less than 1 dB(A).

3.4 Application of this work

The estimation of the uncertainties associated with environmental noise measurements is currently considered to be an important issue. However, probably due to the lack of guidelines for its estimation in standards it is not yet frequently considered. With the presentation of calculation methods and estimation examples in the ISO 1996-2:2011 working draft, in future the uncertainty estimation will need to be considered when reporting measurements. Knowledge of the uncertainty associated with a certain measurement and or calculation will allow more reasoned decision making. It is suggested that further guidelines and worked examples would help to promote the implementation of the uncertainty estimation for environmental noise measurements.

Source of uncertainty	Value (half width)	Conversion (dB(A))	Distribution (divisor)	Standard uncertainty (dB(A))	Comments
Source					
Traffic Flow	10% in 1622	0,44	Rectangular (√3)	0,25	a)
(% HGV)/(Mean Speed)	5%@ 45km/h 15%@60 km/h	0,42	Rectangular (√3)	0,24	b)
Transmission path					
Weather	3 dB(A)	3,00	Rectangular (√3)	1,73	c)
Ground Topography	no change	n/a	-----	n/a	d)
Receiver					
Position	1 m in 10 m	0,87	Rectangular (√3)	0,50	e)
Reflective surface	free field condition verified	none	-----	n/a	f)
Instrument	1.9 dB(A)	n/a	Rectangular (√3)	1,10	g)
Background	minimal	ignore	-----	n/a	h)
Combined uncertainty (root sum of squares)					**2.14**
Expanded Uncertainty (95% confidence [k=2])					**4.28**
Final result					**$L_{Aeq,1hour}$=61,5 dB(A) ± 4,3 dB(A)**

a) and **b)** reference [6] identifies the change in traffic flow and velocity of heavy vehicles, as being the most probably source of variability in the road traffic noise. It considers only two main types of vehicles: the heavy (unlade weight > 1525 kg) and the others. **c)** Value considered for favourable meteorological conditions. **d)** The ground topography, between source and receiver, is not expected to change after the construction of the building. **e)** To evaluate the uncertainty associated with the position of the sound level meter in relation to the future site of the most exposed facade of the building was evaluated. It is considered that the site is at 10 meters from the middle of the closer lane with a standard uncertainty of ± 1 m. Using the inverse square law, this influence can be converted in dB(A) and then re-scaling to a symmetrical uncertainty interval of equal width. **f)** It was verified the condition of free-field. **g)** As considered in [6]. **h)** The background noise could not be determined on site, as it was not possible to stop road traffic. Considering the parameter $L_{A95\%}$ as background noise, as suggested in [5], it can be considered that the background noise influence over the $L_{Aeq,1h}$ was minimal as there is a difference between the $L_{Aeq,1h}$ and the $L_{A95\%}$ of 10,4 dB(A).

Table 11 – Uncertainty calculation of the one-hour L_{Aeq} measurement according to DTI Crave [6]

3.5 Some rules of thumb

The following rules of thumb can be applied to reduce uncertainty in environmental noise measurements:

1. The Uncertainty Budget should include detailed assessment of all sources of error;
2. To reduce uncertainties in environmental noise measurements:
   2.1 Use weather forecasts when planning
   2.2 Record and report meteorological conditions
   2.3 Measure under favourable propagation conditions unless specific conditions are required.
3. For long term averages:
   3.1 Determine statistical spread of weather classes
   3.2 Plan measurement sessions accordingly.

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References

1. Joint Committee for Guides in Metrology (JCGM). GUM - Evaluation of measurement data — Guide to the expression of uncertainty in measurement, Bureau International des Poids, 2010
2. Environmental Noise Directive 2002/49/EC.
3. Imagine workgroup. IMA32TR-040510-SP08. *Determination of* L_{den} *and* L_{night} *using measurements*, 2011.
4. International Standard Organization (ISO). ISO 1996-2:2007: Acoustics- Description, measurement and assessment of environmental noise- Part 2 : Determination of noise levels, Geneva, 2007.
5. ISO TC43 SC1 Working Group 45. ISO 1996-2:2011 Acoustics – Description, measurement and assessment of environmental noise – Part 2 : Determination of environmental noise levels (11-02-02) 2nd working draft
6. Craven, N.J.; Kerry, G. *A good practice guide on the sources and magnitude of uncertainty arising in the practical measurement of environmental noise*, The University of Salford - School of Computing, Science & Engineering, Salford- Greater Manchester (UK), 2007. http://usir.salford.ac.uk/20640/ Last viewed 20 Aug 2012
7. Hoare Lea Acoustics; Ian Flindell and Associates; The English Cogger Partnership, Berry Environmental Ltd & Nicole Porter. Environmental Sound Measurements: Managing Variability, Uncertainty & Risk, National Physical Laboratory (NPL), 2006.
8. International Standard Organization (ISO). ISO 1996-1:2003: Acoustics- Description, measurement and assessment of environmental noise- Part 1: Basic quantities and assessment procedure, Geneva, 2007.
9. Peeters, B.; (Imagine WP2). Review of data needs for road noise source modelling, 2004.
10. Dittrich, M. The IMAGINE model for Railway Noise Prediction. Forum Acusticum, Budapest, September 2005
11. Jones, R.; Dittrich, M.; van der Stap, P.; Zhang, X.; Block, J. R. D12/ D13 Rail noise database and manual for implementation. IMAGINE,2007
12. Railway Portuguese Company web site, www. cp.pt, (01-04-2012)
13. Rosão, V.; Abreu, L.; Conceição, E.; Leonardo, R. Especificidades da monitorização do ruído de tráfego ferroviário, 4ª Conferência Nacional de Avaliação de Impactes, Vila Real, Outubro 2010
14. Alves, S. A revision of the uncertainties guide for environmental noise measurement, The University of Salford - School of Computing, Science & Engineering, Salford- Greater Manchester (UK), 2012

Speech intelligibility in higher education teaching facilities

By Iain Paterson-Stephens, Peter Rutherford and Robin Wilson, all of the University of Nottingham

Abstract
This paper expands upon the initial work conducted by Rutherford, Wilson and Hickman[4] and explores the relationship between the Speech Transmission Index (STI) and its application within the context of higher education teaching and learning facilities. As is well known, the modern learning environment comprises a diverse student population of both native [L1] and non-native [L2] listeners and speakers and, as has been evidenced in research and recognised within BS EN 60268-16:2011[16], such [L2] listeners provide a significant challenge when predicting STI performance in any given space.

The purpose of the research presented here is to delve deeper into the relationship between STI and both native and non-native listening groups. Data is presented that extends the findings from the original study, particularly with respect to the relationship between the STI value and [L2] listener performance. The paper concludes that whilst STI over predicts [L2] listener performance, the level of over-prediction itself is fundamentally dependent upon the STI value. For high STI values (>0.8), a relatively small over prediction was observed during intelligibility experiments (approx. 6%) however at low STI values (<0.5), a much higher over prediction was observed (approx. 40%).

Such findings clearly point to the need to look more critically at Speech Transmission and Speech Intelligibility as metrics for evaluating room acoustic performance for diverse, international populations.

Introduction
It is fair to say that UK higher education institutions have experienced significant changes to their student population over the past 15 years or so. The widespread introduction of tuition fees in the mid to late 1990s combined with significant emphasis placed on overseas and national recruitment has resulted in not only greater student numbers, but increasingly fierce competition between higher education (HE) institutions. As a result, many departments and courses have seen both growth in class sizes and a much higher proportion of non-native English speakers than in previous years.

When applying for courses, many applicants rank institutions based on nationally published performance metrics such as the National Student Survey (NSS), which is based on many parameters including teacher performance. Consequently, teaching staff are under increasing pressure to improve delivery of teaching and demonstrate this by providing evidence, such as student ratings, these often serving as key performance indicators used as part of annual staff appraisal processes. This throws into focus the relationship between teacher, learning environment and the influence these have on a student's learning experience. For example, if a lecture theatre used for teaching does not promote good quality transfer of speech, then students are less likely to follow and engage with the material taught in-class. Their performance overall may suffer and their perception (and rating) of the teacher may be reduced. The teaching environment therefore has the potential to impact negatively both on lecturer and student and by implication the institution offering taught programmes.

Good acoustic design is an essential aspect of any indoor space used for teaching and learning. The ability of the space to support effective transfer speech is of prime consideration and the key factors that determine this are the level of background noise present within the space and the reverberant qualities of the space itself. This study investigates a number of typical teaching spaces used within an HE establishment and attempts to assess their suitability for supporting speech transfer in the context of a typical cohort of mixed native and non-native English students.

Guidelines given in Building Bulletin 93, BB93[1], make clear recommendations about the appropriate level of background noise and reverberation times for different types of activity. The scope of BB93 is however limited to LEA-funded nurseries, schools and FE colleges. No agreed standard or set of guidelines exist that relate specifically to the design of HE teaching spaces. Despite the limited regulatory scope of BB93, the nature of the spaces it addresses means many of its recommendations relating to speech transfer characteristics may be reasonably applied to the HE context[2]. Some of the recommendations given in BB93 are based on standard objective measures of speech transmission (e.g. STI), which are based on communication between native speakers and listeners. However, given that in a typical UK university the population will consist of a wide mix of native [L1] and non-native [L2] English speaking students and staff, it is unlikely that native-to-native communication will be the norm. This being the case, it is likely that teaching spaces will need to be designed to meet more demanding STI criteria than the base level recommendations of BB93 would suggest. Indeed, a number of studies[3,4,5,6,7] have shown that STI may incorrectly predict the performance of an acoustic space by as much as 20-30% for non-native listeners.

In response, this study sought to address two fundamental questions; (a) '*how well does a modern HE teaching environment perform in the context of different listener groups?*' and (b) '*how well do the accepted Speech Transmission metrics predict this performance?*'. In attempting to answer these questions, two specific aims were set as follows; 1) to evaluate a cross section of teaching spaces within a UK university with regard to Speech Transmission capabilities and acoustic characteristics in order to determine the range that exists and its quality relative to published guidelines. 2) to assess both the accuracy and limitations of the conventional Speech Transmission Index, STI, as a metric when used to predict the speech intelligibility characteristics of teaching spaces used by a typical cohort of university students i.e. a cohort P44

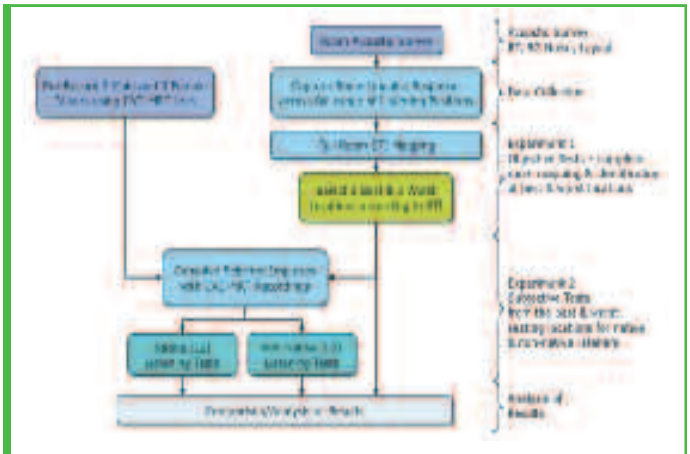

Figure 1 Experimental procedure – repeated for each teaching space


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P42 containing a mix of native [L1] and non-native [L2] English speaking participants.

Experimental procedure

Procedure overview

For this study, two main experiments were developed; objective measurements and subjective listening tests (Figure 1). These were then used to explore five different HE teaching spaces.

After an initial room acoustic survey of each teaching space to determine reverberation time (RT) and A-weighted background noise levels, the following investigations were carried out:

1. Experiment 1 - A comprehensive, objective investigation of each of the five teaching spaces that sought to determine the spread of speech transmission capability across the full range of listening positions within each room. This comprised a suite of STI measurements at multiple locations that sought to identify the three 'best' and three 'worst' locations, for each room.
2. Experiment 2 - For the six selected locations in each room, subjective assessments were conducted using two groups of listeners i.e. a native English speaking group [L1] and a non-native English group [L2].
3. From the two experiments, the ability of STI to predict speech transmission capability was compared with the observed performance of the [L1] and [L2] groups.
4. The relative performance of the [L1] compared with the [L2] group was also assessed and the extent to which STI under or over predicts the performance of the [L2] group was determined.

Method in detail and relevant Standards

Room acoustic survey

The relevant recommendations, to this investigation, from BB93 are shown in Table 1.

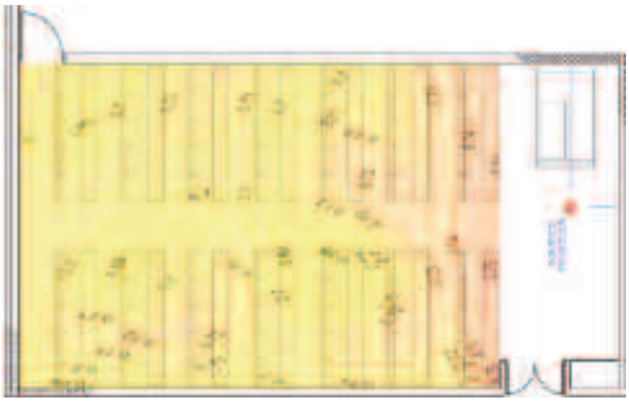

Figure 2 – Room STI map produced using MATLAB STI functions

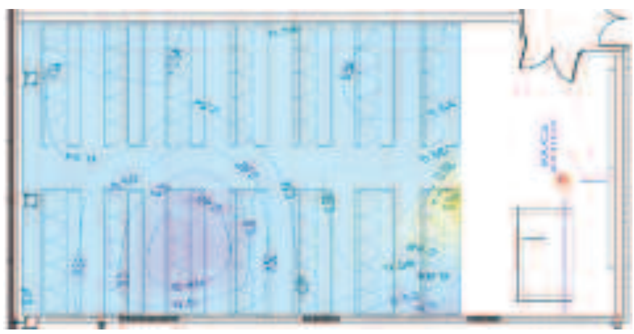

Figure 3 Room STI map for Room 5, the 'worst' performing room according to STI

For the acoustic survey, three assessments were carried out; visual inspection, background noise assessment and reverberation time assessment. Noise level assessments were carried out in terms of the 30 minute A-weighted average i.e. LAeq,30, and reverberation times in terms of the mid-frequency average, i.e. T_{mf} in seconds. Both of these measures were chosen so as to be comparable to the values specified in BB93 and shown in Table 1.

Reverberation time measurements were carried out as described in BS-EN-ISO: 354(2003)[8] and the method referred to as the 'Indirect version of the Integrated Impulse Response Method' was chosen. All RT measurements were carried out using B&K DIRAC software with the test source signal set to an exponential sweep sequence, which was presented using a high power omnidirectional loudspeaker.

Objective assessments (STI)

For the STI measurements, Impulse responses were captured between a source 'teaching position' and a number of receiver 'listener' positions selected from the full range of available positions within the room as defined in BB93. Typically, impulse responses were captured for around 50% of the available seating positions. This gave a good cross section of the positions available and generated sufficient data to judge the variation in performance for each teaching space. Impulse response measurements were made using a dual source high quality (non-ported) loudspeaker, approximating[2,9] an artificial mouth[10], which should lead to an STI error of no more than the typical standard deviation of STI i.e. <0.02[17,18]. For each of the measurements, the relative height and placement of the source (loudspeaker) and receiver (microphone), along with calibration protocols all followed the guidelines as set out in the relevant standards[1,16] and published research[3,4,17,18].

All impulse responses were captured using B&K DIRAC software via an Earthworks M30 omnidirectional measurement microphone moved to each 'listening' position in turn. The source loudspeaker was located at 1.65m above floor level and the receiving microphone was located at head height for a typical adult in a sitting position, i.e. 1.2m. STI calculations were performed using B&K DIRAC software and various STI functions written for MATLAB used to produce room 'maps' of STI capability, an example of which is shown in figure 2. The room STI maps were useful in terms of helping to identify areas within each teaching space where STI performance

Type of room	Noise tolerance	Upper limit for the indoor ambient noise level LAeq,30 (dB)	T_{mf} (seconds)
General teaching areas, small group rooms	Low	35	<0.8
Small lecture rooms (fewer than 50 people)	Low	35	<0.8
Large lecture rooms (more than 50 people)	Very low	30	<1.0

Table 1 Recommended performance criteria for teaching spaces as defined in BB93

Room	Type	Seats	Features		T30(s)	STI	LAeq,30
1	Large Tiered Lecture Theatre	250	Old build. Diffusion panels & reflectors distributed throughout the room. Carpet and soft furnishings throughout	mean	1.0s	0.64	38dB(A)
				stdev	0.062	0.045	
				range	0.91-1.08	0.57-0.73	
2	Large Flat Lecture Room	150	Refurbished in the late 90's. Acoustic absorbers above head height on walls. Carpet, curtains and freestanding tables & soft covered chairs.	mean	1.2s	0.64	44dB(A)
				stdev	0.054	0.044	
				range	0.55-1.28	0.51-0.79	
3	Medium Tiered Lecture Theatre	65	Modern design, diffusion panels on back wall, carpet and curtains. Soft furnishings throughout.	mean	0.8s	0.72	47dB(A)
				stdev	0.079	0.041	
				range	0.84 - 0.92	0.65-0.80	
4	Medium Tiered Lecture Theatre	60	Carpet. Reflecting panel above 'stage' area. No other treatment.	mean	1.0s	0.71	38dB(A)
				stdev	0.071	0.019	
				range	0.89-1.13	0.67-0.75	
5	Small Flat Lecture Room	45	Carpet and curtains. No acoustic treatment. 'Hard' painted concrete walls and ceiling. Narrow 'corridor' design to the room with a high ceiling.	mean	1.7s	0.54	42dB(A)
				stdev	0.134	0.035	
				range	1.50-1.95	0.47-0.60	

Table 2 Results of analysis of selected teaching rooms

was particularly good or poor – an interesting exercise in itself in relation to the architectural or acoustic features present.

Subjective assessments (word scoring)

For each of the rooms tested, the three 'best' and three 'worst' seating positions, according to STI were selected for further investigation using groups of [L1] and [L2] listeners. Listening tests were conducted in a listening booth and in-line with the approach already established by other researchers[4,11]. Also, as far as possible, all subjective listening tests followed the guidelines as given in ISO: 9921(2003)[12] and were designed to be in accordance with ISO:TR-4870(1991)[13]. This approach offers great flexibility for the listening group in terms of when and for how long listening tests are conducted. Also, the access time required in the acoustic space is kept to a minimum.

A total list of 300 words, organised as six sub-sets of 50, were used in this study. The list was designed as a phonetically balanced set of CVC rhyming words, which were presented in a closed-set form. This type of listening test lends itself well to automated data collection which was a necessary consideration due to the number of tests to be conducted. The complete 300 word list was vocalised by three male and three female speakers. Prior to vocalising the list, each speaker was given some training and an opportunity to practice. Speakers were asked to practise vocalising the sounds at a consistent rate and level of presentation and to avoid putting any intonation or emphasis on words as they are spoken. To help with this a sound level meter and a visual metronome (flashing led) were placed in front of the speakers. This helped them to monitor their levels as they spoke and to fall into a rhythmic pattern of vocalising the words at a set rate. Speakers were asked to vocalise each word within an agreed carrier phrase, i.e.: "You will mark '*test word*' now". All vocalised words were recorded in a quiet semi-anechoic environment using a measurement microphone connected to a computer with recording software.

After being convolved with the impulse responses of the selected listening positions, the vocalised lists were presented to the listeners in random order so as to reduce the likelihood of listeners learning a set pattern of words over a series of tests. All vocalisations were presented to the listener in a quiet listening booth over closed-back headphones, which were set up for a listening level of 70 dB (SPL). Printed machine readable *Speedwell* response sheets were prepared and shown to the listeners prior to each test. Listeners were asked to respond to each vocalisation by identifying the word spoken from the listed alternatives. Listeners were informed that they could stop the experiment at any point, take a break and/or come back on different days in order to complete the tests. Two groups [L1] and [L2] of eight subjects each were assessed, details of which are:

Group 1 – Native speaking English students: *[L1] Listeners: L1-1 to L1-8*. Age range: 18-25. Average age: 19 years. Sex: 4 male and 4 female equally distributed between the two groups. P46

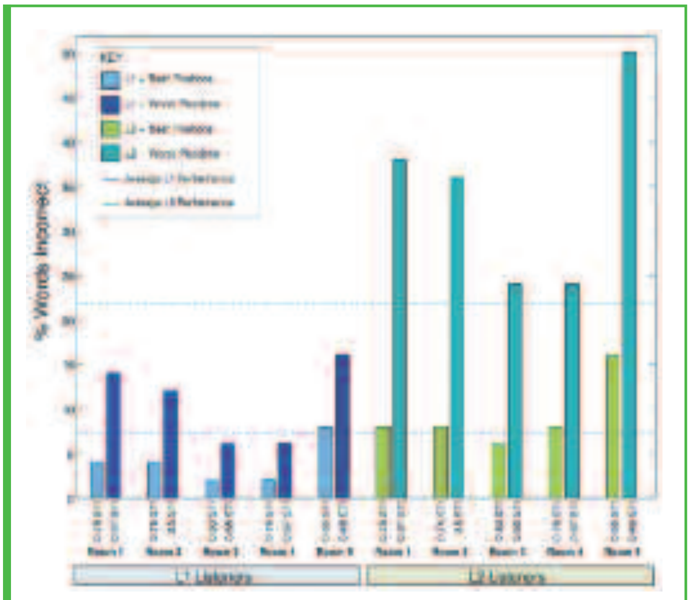

Figure 5 Comparison of [L1] to [L2] listener performance in terms of the average number of words incorrect (as a percentage) for the 'best' and 'worst' positions in each room

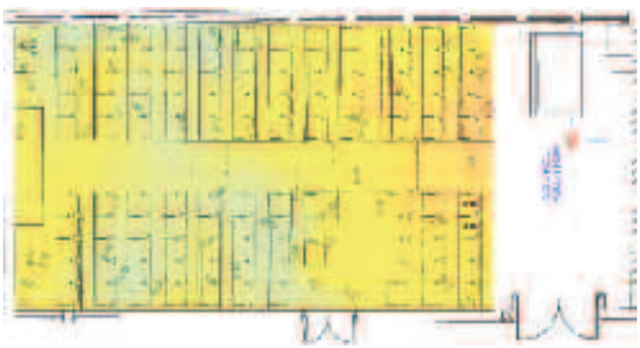

Figure 4 Room STI map for Room 3, the 'best' performing room according to STI

Room	Bad & Poor (0 to <0.3 to <0.45 STI)	Fair (0.45 to <0.6 STI)	Good (0.6 to <0.75 STI)	Excellent (0.75 to 1.0 STI)
1	0 %	11 %	87 %	2 %
2	0 %	11 %	89 %	0 %
3	0 %	0 %	78 %	22 %
4	0 %	0 %	97 %	3 %
5	0 %	95 %	5%	0 %

Table 3 Percentage of measurement points within each STI band

	ROOM 1				ROOM 2				ROOM 3				ROOM 4				ROOM 5			
	Best Positions		Worst Positions		Best Positions		Worst Positions		Best Positions		Worst Positions		Best Positions		Worst Positions		Best Positions		Worst Positions	
	L1 (A)	L2 (B)	L1 (C)	L2 (D)	L1 (A)	L2 (B)	L1 (C)	L2 (D)	L1 (A)	L2 (B)	L1 (C)	L2 (D)	L1 (A)	L2 (B)	L1 (C)	L2 (D)	L1 (A)	L2 (B)	L1 (C)	L2 (D)
Mean Errors per Person	2	4	7	11	2	4	6	18	1	[illegible]	3	12	1	4	2	12	4	[illegible]	8	25
Standard Deviation	1.00	2.45	1.85	3.88	1.10	2.02	1.81	8.21	0.74	2.37	0.81	5.50	[illegible]	2.88	[illegible]	[illegible]	1.25	3.96	2.25	[illegible]
Error (words incorrect)	0 - 4	[illegible]	4 - 13	11 - 23	0 - 4	1 - 9	3 - 10	7 - 31	0 - 2	0 - 10	1 - 6	4 - 23	[illegible]	[illegible]	1 - 4	6 - 20	1 - 7	2 - 14	4 - 12	[illegible]
Average Observed %	96	[illegible]	84	52	95	92	88	56	98	91	93	69	97	93	92	69	[illegible]	[illegible]	[illegible]	[illegible]
Predicted % (from STI)	96	96	80	80	96	96	90	90	99	98	96	96	97	97	96	96	[illegible]	[illegible]	[illegible]	[illegible]
Average Measured STI	0.7	0.7	0.6	0.6	0.7	0.7	0.5	0.5	[illegible]	[illegible]	0.7	0.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	A:B	C:D	A:C	B:D	A:B	C:D	A:C	B:D	A:B	C:D	A:C	B:D	A:B	C:D	A:C	B:D	A:B	C:D	A:C	B:D
Ratio of Mean Errors	2.2	2.9	3.3	4.8	2.3	[illegible]	3.1	4.0	3.6	4.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 4 Comparative results for the L1 & L2 listener performance for each room.

◄P45 No reported hearing impairment and all students were subsequently assessed as having 'normal' hearing. All native students had <8 months at the University.

Group 2 – Non-native English speaking students (four Saudi, four Chinese: *[L2] Listeners: L2-1 to L2-4 (Saudi Arabia) and L2-5 to L2-8 (Chinese).* Age range: 18-22. Average age: 19 years. Sex: four male and four female distributed evenly between the two groups. No reported hearing impairment and all students were subsequently assessed as having 'normal' hearing. All students had <8 months at the University and had been resident in the UK for <nine months. All non-native listeners held an English language qualification of IELTS 6.0 with all assessed elements (reading/writing/listening and speaking) at IELTS 5.5 or above.

Results and discussion

Room acoustic measurements

For this study, a cross section of teaching spaces was selected for assessment ranging from small flat lecture rooms to large tiered lecture theatres. In total five spaces were chosen for detailed analysis, as outlined in Table 2. For each teaching space, detailed room acoustic parameters and multi-position STI, measurements were taken, also presented in Table 2. At the time of taking the measurements, the room was unoccupied and speech reinforcement systems and other classroom equipment were not in operation.

Comparing the results shown in Table 2 with the expected BB93 criteria shown in Table 1, it is clear that not all of the teaching spaces assessed fully meet the criteria. Background noise level measurements for all rooms were higher than the BB93 expectation. A predominant issue appeared to be extraneous noise infiltration via either/or both of the following key mechanisms: 1) poor isolation from neighboring corridors and/or poorly isolating windows, and 2) poorly designed forced air ventilation systems which appeared to be significant generators of background noise within each space. In terms of the room acoustic measurements, the worst performing room was room 5, which had an average STI figure of 0.54 and a relatively long reverberation time of 1.7 seconds, this room is illustrated in the room STI map of Figure 3. The room with the best overall performance, taking into account noise level, reverberation time and STI was room 3 and this supports an anecdotal view held amongst a number of teaching staff using the different spaces on a regular basis. The room 3 STI map is shown in Figure 4.

Despite the acoustic performance issues, all of the rooms apart from room 5, contained at least some listening positions, that met the speech intelligibility qualification of 'good' according to the ISO:9921(2003)[12] scale. However the spread of STIs in any room was observed to be quite large and dependent upon position within the room. Table 3 shows the percentage of measured STI points that fell within each qualification interval and this leads us to the notion of the 'best' and 'worst' listening position within each room.

[L1] and [L2] Listener performance – results and discussion

Putting the measured acoustic performance data from Tables 2 and 3 into context of real listeners, Table 4 compares the average listener performance made by the [L1] and [L2] groups in each of the different rooms.

Figure 5 depicts actual room performance in terms of the average number of words interpreted incorrectly as a percentage of the total words observed. This gives a tangible appreciation of what the differences in STI mean for real listeners in each situation.

From Figure 5, in the apparently best room according to STI, room 3, and the best seats, [L1] listeners made on average 2% errors while the [L2] listeners averaged at around 6% errors. Going to the apparently worst performing room, room 5, [L1] listener performance was 7% errors at best and 15% at worst while the [L2] listeners achieved 16% errors at best and 50% errors at worst. The results indicate that the [L2] listeners tend to cope well in the best performing rooms (and best positions) and even perform almost on a par with the [L1] listeners. However, as the quality of the acoustic environment is reduced, the [L2] listeners are progressively less able to cope and make a significantly higher proportion of errors compared with the [L1] group.

The data presented here suggest that on average [L2] listeners are at a disadvantage to some extent in all rooms tested, in terms of their experienced speech intelligibility. However, listener performance also varies within each room and more often than not, the best performance can be achieved close to the front and centre and/or as near as possible to the lectern. In a sense this is not surprising that listeners can 'hear better at the front' but what the results also suggest is that the [L2] listeners are much more affected by sitting away from the front than the [L1] group. While seating position may not necessarily affect student performance in terms of grades achieved at the end of a course[19,20], numerous studies[20,21] have shown that student engagement, ►

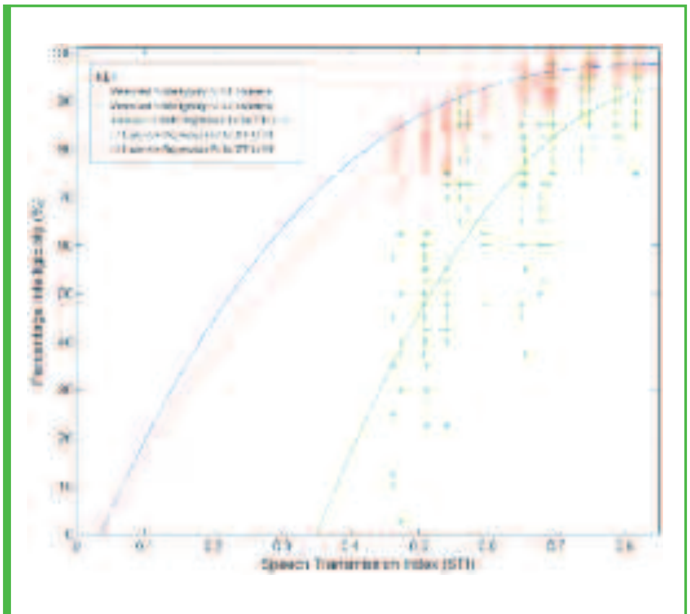

Figure 6 %Intelligibility for [L1] & [L2] listeners -vs- measured STI for all rooms and locations

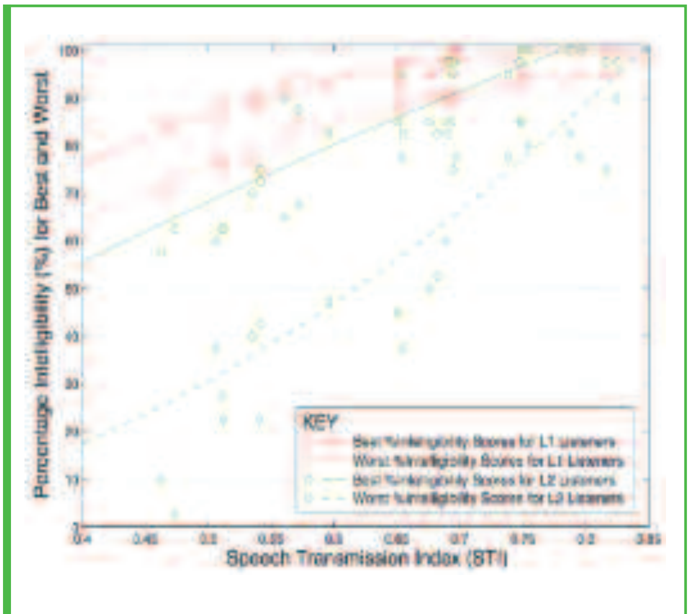

Figure 7 %Intelligibility for 'best' & 'worst' performing [L1] & [L2] listeners, all rooms and locations enjoyment and evaluation of the learning experience (and the teacher) is very much affected by seating position. A major factor in this is the extent to which the student is able to attend to and engage in dialogue with the teacher - factors that are influenced significantly by the quality of the communication channel.

Figure 6 depicts the observed speech intelligibility for the [L1] and [L2] groups across all of the rooms and listening positions plotted against the measured STI in each location. Of considerable importance in this study is the discovery that the degradation in performance for [L2] listeners is much more rapid than for [L1] listeners, this is clearly illustrated by the best fit curves for the [L1] and [L2] data sets shown. For the rooms evaluated the intelligibility tests show that STI is a reasonably reliable predictor of intelligibility for [L1] subjects since the intelligibility scores and STI match quite closely. This point is further illustrated by the best fit observed by Anderson & Kalb[15] for their experiment involving [L1] listeners only – shown in Figure 6 as the upper (blue) curve.

Referring to the [L2] listener data shown in Figure 6, it is apparent that STI is not a reliable predictor of perceived intelligibility for the [L2] group. For this group, Figure 6 shows that there is a very clear and marked difference in performance particularly at the lower end of the STI range. Furthermore, the [L2] best fit curve has a considerably steeper decay rate than that observed for the [L1] group and/or by Anderson & Kalb[15] in their [L1] only experiment. Taking this further and splitting the data into the 'best' and 'worst' listeners within the [L1] category, as shown in Figure 7, it is apparent that there are variations, particularly towards lower STIs, between the 'best' and 'worst' listeners but in general their performance is quite similar – this suggests some inter-subject variation as would be expected within a normal listening population. However, also shown in Figure 7, are the 'best' and 'worst' [L2] listeners for whom there is a much greater inter-subject variation within this group.

Looking at the 'best' [L2] listeners shown in Figure 7, it can be seen that at STIs above about 0.7, their performance is comparable to the general [L1] population, this evident where the best fit curves cross between the best L2 listeners and worst L1 listeners. However, for the 'worst' [L2] listeners in that group, they require the STIs to be in excess of about 0.8 for their performance to be comparable. What is also very apparent is the degree of separation between the best fit curves for the [L2] listeners. For the 'best' [L2] listeners, below an STI of 0.7 the trend clearly shows that the room is definitely affecting their performance to a greater extent than for the 'worst' [L1] listeners. But the problem really shows for the 'worst' [L2] listeners for whom their performance drops off very rapidly. Clearly, STI is not a reliable predictor of performance for the 'worst' [L2] listeners.

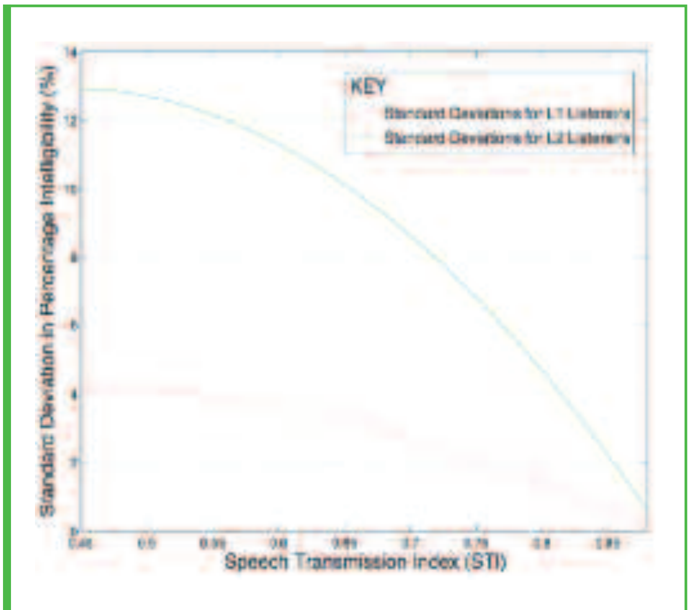

Figure 8 Standard deviations in %Intelligibility for [L1] & [L2] listeners

Looking at the standard deviations in [L1] and [L2] listener performance, as shown in Figure 8, the differences in inter-subject variation are apparent. For [L1] listeners, there is relatively little inter-subject variation overall, especially towards higher STIs although this does increase towards lower STIs as would be expected. For [L2] listeners however, the inter-subject variation is much larger. If we take the 4 standard deviations in percentage intelligibility as a benchmark, this is reached at an STI of 0.45 for [L1] listeners but, for the [L2] listeners the same standard deviation is reached at an STI of about 0.82. At lower STIs the standard deviation for [L2] listeners increases rapidly - yet these students all have similar/equivalent comprehension/listening scores based on an internationally accepted metric for language comprehension (IELTS).

Conclusions

One might expect that [L2] listeners with similar IELTS scores would have decay curves not too dissimilar to that of the [L1] population, i.e. you would expect the standard deviations to be roughly the same for both groups as this is an indicator of inter-subject variability. However, this was not the case, for the [L2] students there was a massive discrepancy in intelligibility. There was also some variation in the [L1] student population but this variation was considerably less at high STIs. One might conclude from this that the STI rating of 'Good' is just not acceptable for the [L2] population and even for the [L1] population there is some impact. Indeed anything lower than an STI of 0.75 or so is just not good enough. Considering that only 10% of all measured positions in this study exceeded this criteria, then the current aspirations in the design of teaching spaces appear not to be high enough.

In answering the question; '*How well does the accepted Speech Transmission metric predict [L1] and [L2] performance?*', the study suggests that for some (including the [L2] population at certain STIs) the metric is a good predictor of performance. However at low STIs there are some significant problems for [L2] listeners in particular. The BS-EN-60268-16 standard does discuss correction factors for [L2] groups which are broadly graded into various listening abilities. However this study tested for one of these specific groups and found that even within one group of listeners with apparently similar ability (according to IELTS) there was wide variability. This does raise some questions about either the recommendations within the standard concerning those specific listener groups and / or the robustness of currently accepted English Language proficiency tests such as IELTS. In both cases, whilst they are obviously useful they do need further clarification.

For the [L1] and [L2] population, it was shown that above about 0.75 STI, the 'worst' of the [L2] population lies within the STI of about 0.6 for the [L1] population. Below this point, [L1] performance decreases but in comparison the [L2] population is highly disadvantaged. However, this is not consistent across the whole [L2] population as the 'best' [L2] listeners (whilst performing worse than the 'worst' [L1] listeners) still find things to be reasonably intelligible at lower STIs. The 'worst' [L2] listeners on the other hand really struggle - and given our duty of care to be inclusive and provide learning environments that are suitable for all, we are obviously failing on those duties. Universities therefore need to increase their aspirations and design environments with very high STIs thus not disadvantaging our general [L2] population.

References

1. BB93, Building Bulleting 93, DfES – UK, ISBN:0-11-271105-7. (2003).

P48

2. P47 Shield, B.M. and Dockerell, J.E., External and internal noise surveys of London primary schools. Journal of the Acoustical Society of America, 115, 730-738. (2001).
3. Wijngaarden, van S.J. and Verhave, J.A., Advances in STI Measuring Techniques, Proceedings of the Institute of Acoustics. (2005).
4. Rutherford, P., Wilson, R. and Hickman, V., (2006), IOA – Intelligible Measurements Conference Paper, London. (2006)
5. Steeneken, H.J.M. and Houtgast, T., A Physical Method for Measuring Speech Transmission Quality, Jnl of the Acoustical Society of America, Vol:67, pp:318-326. (1980)
6. Winjgarden, van S.J., Steeneken, H.J.M. and Houtgast, T., Quantifying the Intelligibility of Speech in Noise for Non-Native Listeners, Jnl of the AS of America, Vol:111(4). (2002)
7. Winjgarden, van S.J. et al., Using the Speech Transmission Index for Predicting Non-Native Speech Intelligibility, Jnl of the Ac' Soc' of America, Vol:115(3), pp:1281-1291. (2004).
8. BS-EN-ISO:354:2003, British Standard, Acoustics – Measurement of Sound Absorption in a Reverberation Room. (2003).
9. Mapp, P., Measuring Speech Intelligibility in Classrooms, with without Hearing assistance, IOA Proceedings, Vol:25(7) pp:156-160. (2003).
10. ITU-T:P.51-1993, Telephone Transmission Quality Objective Measuring Apparatus: Artificial Mouth, International Telecom's Union, ITU, Recommendation P.51. (1993).
11. Houtgast, T. and Steeneken H.J.M., Past, present and future of the Speech Transmission Index, TNO Human Factors, Soesterberg, The Netherlands, ISBN 90-76702-02-0. (2002).
12. ISO:9921-2003, Int' Standard, Ergonomics – Assessment of Speech Comm's. (2003).
13. ISO:TR-4870-1991, International Standard, Acoustics – The Construction and Calibration of Speech Intelligibility Tests. (1991).
14. Jacob, K.D., Correlation of Speech Intelligibility Tests in Reverberant Rooms with Three Predictive Algorithms, Jnl. of the Audio Engineering Society, Vol:37, pp:1020-1030. (1989).
15. Anderson, B.W. and Kalb, J.T., English Verification of the STI Method for Estimating speech Intelligibility of a Comm's Channel, Jnl of the Ac' Soc' of America, vol:81, (1987).
16. ISO:EN-60268-16-2011, International Standard, Sound System Equipment – part 16: Objective Rating of Speech Intelligibility by Speech Transmission Index. (2011).
17. Mapp, P., Introduction to Intelligibility Measurements and Common Error Mechanisms, IOA Conference Paper, London. (2006).
18. Mapp, P., Error Mechanisms in Speech Intelligibility Measurements, IOA – Intelligible Measurements Conference Paper, London. (2006).
19. Williams, R.L., Relationship of Class Participation to Personality, Ability and Achievement, Jnl of Social Psychology, 83, 193-198. (1971).
20. Stires, L., Classroom Seating Location, Student Grades and Attitudes: Environment or Selection? Jnl of Environment & Behavior, 12, 241-254. (1980).
21. Montello, D. R., Classroom Seating Location and its Effect on Course Achievement, Participation and Attitudes, Jnl of Environmental Psychology, 8, 149-157. (1988).

Aircraft noise causes heart attacks as pirates cause global warming

With 20 years' experience in airport noise and an advocate of balancing the economic, social, environmental and health implications, I have been reading with interest the current debate on the effects of airports.

In recent months, stimulated by, amongst other things, the Airports Commission and some well-timed publication of research, the effects of aircraft noise on health and quality of life has been a hot topic. Sensational headlines and misleading media coverage has ignited the public, particularly in the UK and the United States. The issue deserves debate due to its social implications and current political relevance but I believe restraint and balance should be applied when our profession presents a summary of the conclusions.

Most published studies are able to demonstrate some sort of association between aircraft noise exposure and the risk of certain diseases. Most authors acknowledge the limitations of their studies but they provide valuable published research to inform and enrich the debate, which, by its complex nature, requires a multidisciplinary approach and lacks a simple answer.

For example, in the recently reported study by Imperial College (published in the *British Medical Journal* in October 2013) high levels of aircraft noise were correlated with increased risk of stroke, coronary heart disease and cardiovascular diseases for both hospital admissions and mortality in areas near Heathrow Airport. Similarly, a study published at the same time in the US of around 89 North American airports found a significant association between exposure to aircraft noise and increased risk of hospitalisation for cardiovascular diseases among older people living around airports. It should be noted that the increased risk presented in the US study is significantly less than that of the UK study despite the significantly older population sample.

Neither study provides anything more than a correlation between aircraft noise and relative risk of these conditions – they certainly don't indicate a causal relationship.

When it comes to understanding and interpreting research there is a basic rule that must be applied – correlation does not imply causation. By way of an amusing example, there is a correlation between decreasing numbers of pirates and global warming and increasing numbers of natural disaster cases. Does this correlation mean that declining numbers of pirates are responsible for global warming and natural disasters?

Unfortunately, the general media, specialist publications and even some of the acoustic press have adopted a tone of sensationalism that reveals a partial understanding of the issues. This not only provokes readers but also confuses and unnecessarily alarms people.

Non-technical readers look to us, as professionals, to provide guidance. So, I consider it essential that our profession act in a balanced and considered manner when simplifying research for publishing news. We should recognise the complexities of this issue and should be promoting a contextualised understanding of the challenges that aircraft noise (or noise from any other source for that matter) could have on society and the environment. Otherwise, we are no better than those claiming pirates cause global warming.

Andy Knowles
Managing Director, Anderson Acoustics

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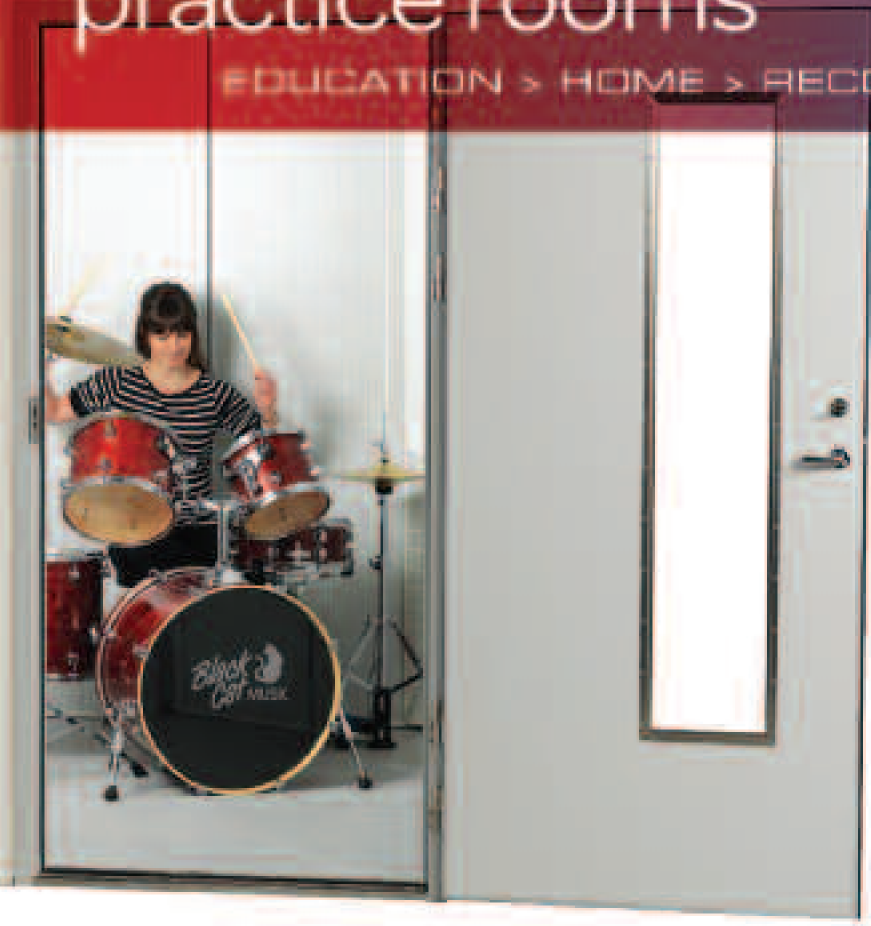

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To watch the video of this interview scan here or go to youtube.com/musicpracticerooms

Pete French - Head of Music, Lancaster and Morecambe College

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Outstanding achievement award for Rupert Thornely-Taylor

Rupert Thornely-Taylor has been presented with an outstanding contribution award by the Association of Noise Consultants.

He was one of the founder members of the association in 1973 and has been involved with it to a greater or lesser extent ever since.

He has served as Chairman, during which time he was instrumental in organising the change from an unincorporated association to a company limited by guarantee in 2005, and has also chaired the group which wrote the “Red Book” on vibration. In 2006 he became President and served in that role for five years. Throughout his work with the ANC he has made available his considerable technical and political skills.

To mark 40 years since the association was formed, an outstanding contribution award has been introduced. Rupert was the clear choice to receive this and it was presented to him at the ANC meeting in January.

Rupert Thornely-Taylor (right) receives his award from ANC Chairman Phil Dunbavin

No Barrier for Pedro at Echo

Pedro Morchon has been appointed European Marketing Manager of Echo Barrier. He joins from Noistop where he was International Sales Manager.

Echo Barrier’s sound reduction products are used on construction sites around the world, including London Underground, the new World Trade Centre in New York and the Sydney Rail Network.

Pedro Morchon

John Dinsdale (1951-2014): leading Institute member in the North West

Obituary

By Dave Logan

It is with regret that we have to inform you of the death on 12 January of John Dinsdale, who died suddenly at home aged 62. John was one of the early members of the North West Branch, taking over as Honorary Secretary at the second AGM in 1982, a task that he undertook diligently until 1986.

John trained at the University of Salford on the then new BSc degree course to qualify as a Public Health Inspector (now Environmental Health Officer). He went on to take an MSc in acoustics and made this his specialist subject for several years. In addition to his work on behalf of the IOA, John was an active member of the Chartered Institute of Environmental Health. He held positions in Stockport and Oldham, where he managed the Environmental Protection Team until his redundancy two years ago. John was instrumental in ensuring that noise issues were given due importance in the Greater Manchester area, one example being to ensure that adequate levels of sound insulation were provided between new dwellings during conversion, prior to this being covered by the Building Regulations.

John was also heavily involved in EPUK (Environmental Protection UK), the organisation that co-ordinates the annual Noise Action Week. In recent years his work on contaminated land issues involved work throughout Europe. He always kept an interest in noise, however, not least during his regular spells as a track marshall at Oulton Park motor racing circuit.

His friends and colleagues are all shocked by his untimely death but will remember him as always being cheerful, offering good, solid advice and being invariably helpful in moving things forward, by providing examples of how things should be done “proper”.

Above all, one knew that if John gave his word then it could be counted upon. John’s integrity was never questioned; it was quite obvious to everyone that met him that he had something about him that was steadfast and true.

He was an understated champion and determined to help where others found it too difficult. He was someone who could understand and appreciate your personal point of view; the mark of a good listener and teacher.

John had a cheerful and optimistic demeanour and in time of adversity he could be relied upon to say “Hey, it doesn’t matter, it’s happened, don’t worry about it.”

John Dinsdale (1951-2014)

We will, indeed, miss his dry humour, his endless anecdotes and stories and, of course, his drive for environmental sustainability.

Our thoughts are with wife, Janet, his daughter Jenny and her family and his grandchildren.

IOA Fellow appointed to top research council role

Professor Philip Nelson

Professor Philip Nelson, an IOA Fellow, has been appointed Chief Executive and Deputy Chair of the Engineering and Physical Sciences Research Council (EPSRC), the UK's main agency for funding research in engineering.

Universities and Science Minister David Willetts, announcing the appointment, said: "His impressive track record in academia combined with his industrial background will serve him well in leading EPSRC with its vital role of supporting world-class science and engineering."

Professor Nelson said: "I feel greatly honoured to have been chosen for such an important national role. I am looking forward to working with colleagues across the research disciplines to ensure the continued health of the UK's world-class science base upon which so much of our future prosperity depends."

Professor Nelson is Professor of Acoustics at the University of Southampton where he has served as Pro Vice-Chancellor for Research and Enterprise from 2005-2013, as Director of the University's Institute of Sound and Vibration Research (ISVR) from 2001 to 2005, and as the founder Director of the Rolls-Royce University Technology Centre in Gas Turbine Noise from 1999 to 2001. He also served as President of the International Commission for Acoustics from 2004 to 2007.

A graduate of Southampton, Professor Nelson remains an active researcher, having worked mainly in the fields of acoustics, vibration, signal processing, control systems and fluid dynamics. He led the university's submission to the 2008 Research Assessment Exercise and 2014 Research Excellence Framework. He is currently chairing the General Engineering sub-panel for REF2014.

The director of a number of spin-out companies, he has also served on the CBI South East Regional Council as well as the boards of the University of Southampton Science Park and of the "SET-squared" partnership of Southampton, Bristol, Bath and Surrey Universities. In 2013 he co-founded the Science and Engineering South Consortium of research-focused universities including Oxford, Cambridge, Southampton, Imperial College London and University College London.

The appointment is for four years. Professor Nelson will take up his post on 1 April as the permanent successor to Professor Dave Delpy.

IAC Acoustics sets up new consultancy division

IAC Acoustics has set up a new acoustic and vibration consultancy division at its global headquarters in Winchester. The team, led by Richard Lord, will specialise in advising on acoustic, vibration and pulsation in process piping issues. In particular, the division will help both current and new clients to complete studies on vibration and pulsation for pipelines in the oil and gas industry.

Team members will cooperate closely with colleagues from IAC Sim Engineering in France. The team in Lille has more than 15 years' experience in providing similar advice, including environmental noise mapping, noise exposure and acoustic imaging.

Calum Forsyth, CEO of IAC Acoustics, said: "We are seeing more and more UK companies in the construction and planning sector seeking acoustic consultancy services. Richard Lord and his team are well positioned with their vast experience in the sector to further assist our clients getting the best results in acoustic design."

For more information ring Richard Lord on **01962 873150** or email **Richard.Lord@iac-acoustics.com**

And in another development, IAC has entered a partnership with Diagnostic Instruments (DI), a market leader in audiological instrumentation.

The companies say the agreement ensures that customers will benefit from a larger product range and worldwide delivery. The partnership will be rolled out globally over the next few months.


Richard Lord

The agreement will see the entire portfolio of sound proof cabins from IAC Acoustics integrated into Diagnostic Instruments' product range, from small standard single occupancy cabins and booths to large bespoke rooms.

Cirrus goes Dutch in airport noise link-up

Cirrus Environmental has entered an airport noise monitoring partnership with Casper, a specialist in web-based visualisation and monitoring software for the aviation industry.

The link-up will see the integration of Casper Noise, the Netherlands-based company's web-based noise management system, with Cirrus' Invictus noise monitor (see page 52). Both companies have also agreed to share each other's global network to be able to provide worldwide customers with local support.

Justin Barker, Cirrus Sales Manager, said: "We are delighted to be able to announce this new partnership with Casper which allows us to bring to the market what we believe is the most effective and comprehensive airport noise monitoring system available."

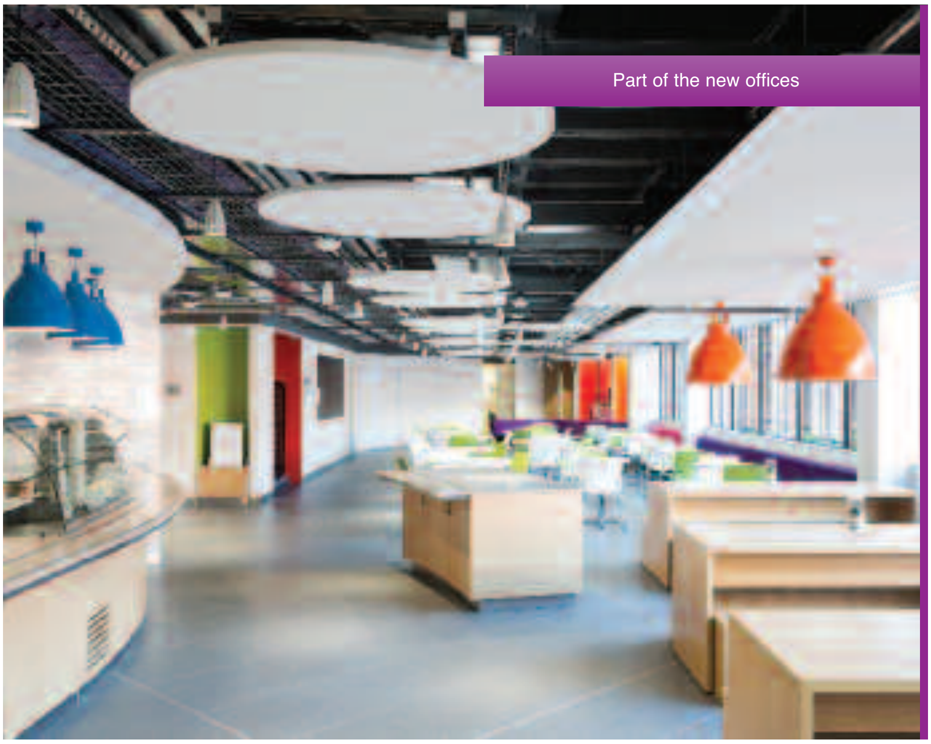
Heleen Erkamp, Casper CEO, said: "We are very excited about the opportunities resulting from this partnership. We strongly believe that our customers will benefit hugely from our combined innovative strengths and customer-oriented approach."

Armstrong provides sound solution for office project

A combination of mineral and metal tiles and canopies from Armstrong Ceilings were used to refurbish a building in Witham, Essex to provide a new home for 600 employees of Cofunds, now part of Legal & General.

Some 3,000m² of Armstrong's white Ultima MicroLook BE 600mm x 600mm tiles in a 6mm Silhouette grid were used in the open office areas while Axiom KE (Knife Edge) canopies with Ultima SL2 planks feature in the reception and corridors, 20 Optima circular canopies in the café and break-out areas, and metal Tegular 2 tiles in the kitchen.

The Ultima mineral tiles meet sound absorption Class C while the Optima mineral canopies provide 2.00 sabines of sound absorption per piece as well as 82% recycled content. Both feature 87% light reflectance.


Part of the new offices

Sonic Wonderland: A Scientific Odyssey of Sound

By Trevor Cox

Review by Ian Bennett

The dust cover on this book invites the reader to turn the pages and listen to the sounds of the thumb brushing against the edges of the paper, and the glue of the spine creaking under the weight of the pages within. There was a moment of anxiety as I opened my copy, in case the spine should give up the struggle and the pages fall out, but the safety margins in paper engineering proved to be more than adequate. I can happily report that the content of the perfectly ordinary pages was in fact extraordinary.

Trevor, our Immediate Past President, has had to broddle into the dusty corners of onomatopoeia to write this book, and has largely succeeded. The reader accompanies him on a series of worldwide sonic adventures, starting prosaically enough down a manhole into a sewer in a London park, and proceeding via a sound walk in a city street to consider the way in which sounds are perceived – or ignored – in everyday life. Having explained the purpose of his book, which is to transpose ideas from the visual experience to the aural experience, he goes on to help us to appreciate both the extreme and the commonplace in our world of sound.

Understandably enough (and to an acoustician, appealingly) the first chapter deals with reverberation. Our intrepid explorer has discovered the most reverberant space in the world, which as it turns out is not a world famous concert hall or cathedral, and not the Hamilton Mausoleum, but a disused oil storage tank at Inchindown, Invergordon (also in Scotland). The mid-frequency reverberation time of 30 seconds, and the extreme value at 125Hz (unimaginably long, but I won't steal the thunder by revealing the figure), justified an entry in the *Guinness Book of Records*, as well as prompting a disbelieving exchange of views online. The colourful description of the journey into the tank armed with acoustical measurement equipment, as well as the word picture of how the acoustic space "felt", invites further exploration into chapters two to nine.

We are taken from the most reverberant place in the world past ringing rocks and barking fish to hear some echoes of the past, then on going round the bend we encounter singing sands and the quietest places in the world. After a chapter on placing sound, which covers acoustics with a musical inclination, the book thinks about future wonders. There is a comprehensive notes section with references and I found the brief index more than sufficient to find any of the places or personalities half-remembered from the text.

There is a map of the sonic wonders of the world ranging through six continents and showing man-made sights (or rather, sounds), animal noises, naturally occurring mineral phenomena, and tidal bores. It may be some time before most of us get anywhere near Lake Baikal in Siberia, but the sound emitted from ice-covered expanses of water can be witnessed, albeit much less spectacularly, next to a frozen pond in your local park.

One chapter has a useful historical summary of echoes in man-made spaces, but it almost inevitably starts with the University of Salford experiments on a duck's quack. Apparently it is widely believed that a duck's quack does not echo, although I must admit I had never heard of this before it appeared in *Acoustics Bulletin* a few years ago. Trevor Cox may be in danger of being remembered primarily for his work disproving the folklore (perhaps there are more pernicious myths he could have busted) but the anecdote does provide a helpful introduction to the way in which echoes were interpreted and analysed in the past. Having recently stumbled on a spectacular flutter echo on a mundane industrial estate in south Manchester, I could quite understand how supernatural forces might have been implicated in a pre-enlightenment age.

The effects of 21st century life on birdsong are quite well documented, but it was still fascinating to have an account of how species might be diverging because of their changing songs: certain sparrows are known to have evolved a variation in the range of frequencies they sing, in order to improve their audibility in cities, and it is quite conceivable that this may result in two separate strains, and eventually species, because of the lack of interbreeding.

The book as a whole is lucidly written and anyone with a background in acoustics, physics or biology will find it an entertaining read. The cover price is very reasonable for a hardback book: although it is not a text book it does have a wealth of information that will still be interesting on second or subsequent visits, not least because the approachable style radiates the enthusiasm and personality of the author. I may well try to visit some of the places described in the book, but I think I will draw a line well before the singing seals of Svalbard.

Published by The Bodley Head,
price £20, ISBN 978-1-84792-210-6

Campbell Associates announces soundBadge launch

Campbell Associates has announced the launch a new acoustic dosimeter, the soundBadge.

With a lightweight design, soundBadge stores recordings four times a second, which, says Campbell, gives a comprehensive picture of sound levels for an entire working day.

It charges and downloads via a USB port, without complicated charging and reader units. When soundBadge is connected to a PC, it automatically appears on screen as a thumb drive and from here files of interest can be opened to view measurement data. The supplied soundView software allows for the removal of unwanted sections of a measurement and enables post data processing and reporting.

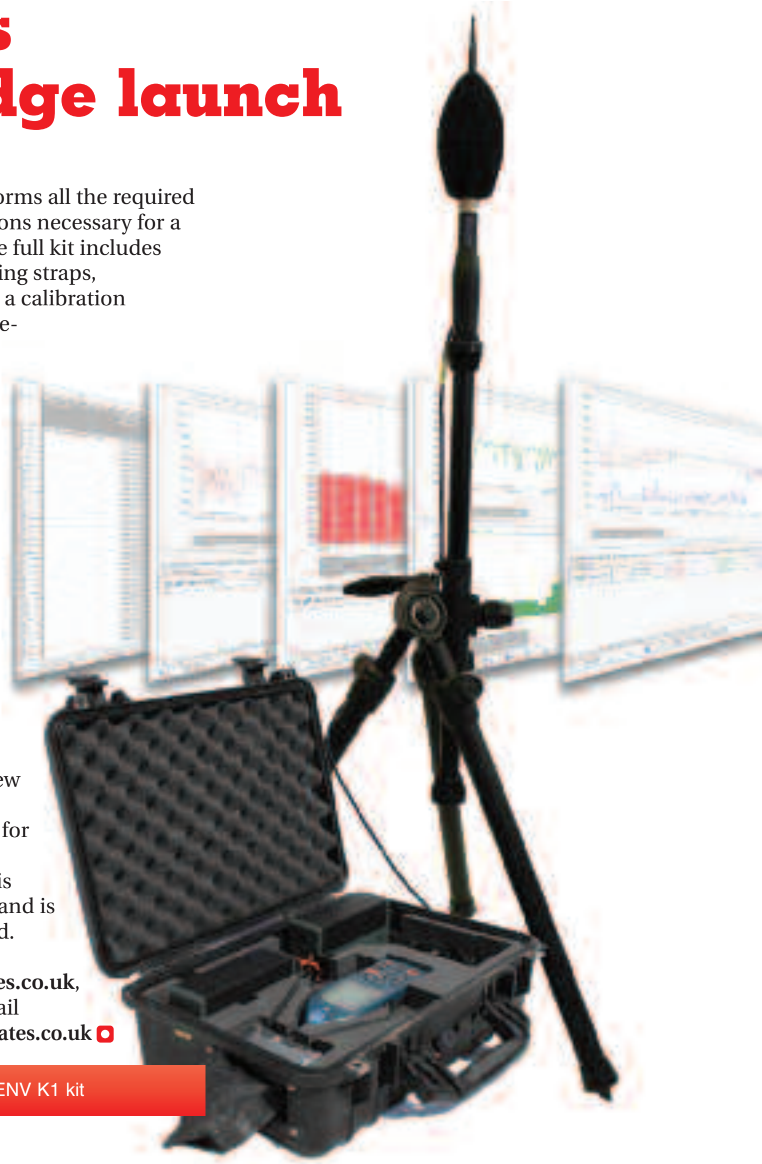
It conforms to all relevant dosimeter standards, and also performs all the required sound level meter functions necessary for a compact instrument. The full kit includes rubber protected mounting straps, soundView software and a calibration adaptor to verify measurement accuracy

The soundBadge dosimeter

And in another move, Campbell has developed a new kit for environmental noise assessments which it says brings a new versatility to remote assessments.

Known as the Nor-140 ENV K1 kit, the kit includes a new weather protected microphone and accessories, a more transportable lightweight outdoor case, new longer life lithium batteries for up to seven days of power and the new and improved version of NorReview software (v5) for uncomplicated data processing. The system is available for sale or hire and is supplied UKAS calibrated.

For more details, visit **www.campbell-associates.co.uk**, ring **01371 87103**, or email **hotline@campbell-associates.co.uk**


The Nor-140 ENV K1 kit

01dB introduces FUSION and CUBE smart noise and vibration monitoring instruments

01dB have launched FUSION, a new sound and vibration analyzer for offline measurements, and CUBE, a new noise monitoring terminal.

With DUO (new version available soon), FUSION and CUBE, the 01dB range is evolving into an ecosystem of smart networked equipment designed to be interchangeable. Each instrument comes complete with compatible accessories and provides data that can be processed using the same software programs.

FUSION, a class 1 sound and vibration analyzer, combines powerful features aimed in particular at facilitating analysis, with a design entirely oriented towards increasing productivity. Downloading data via a WiFi network, remote administration via a 3G network, viewing measurements in real time and so on, FUSION offers multiple communication options. In addition, wireless vibration measurement is proposed for the first time on a sound level meter. Connected to a smart sensor, FUSION offers the possibility to record the vibration signal on three axes at the same time, in parallel with the simultaneous recording of the acoustic signal and storage of acoustic indicators.

CUBE, the second innovative product available from 01dB, is a new noise monitoring terminal which also aims to combine performance and ease of use. In a break from the usual conical shape, this cubic terminal offers various integration options: portable in a carrying case or stationary in a fixed unit. It offers excellent connectivity, with a 3G modem, WiFi connection and Ethernet port. In conjunction with the 01dB WebMonitoring services, CUBE offers a simple and effective solution for deploying acoustic monitoring. Everything from secure cloud storage of data, online presentation of measurements via a customized Web interface and real-time monitoring of alarms is designed to enable users to focus on the essential: the analysis of monitoring data.

For more details go to **http://www.acoemgroup.com/environmental-solutions**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New portable noise monitor from Cirrus

Cirrus Environmental has launched a new portable noise monitor.

The result of two years' in-house development, the Invictus allows simultaneous measurements of all parameters and can be controlled remotely via 3G, GPRS, Wi-Fi Ethernet or radio modems.

Its programming allows the user to set different measurement periods and alerts for different times of the day/different days of the week.

It can also deliver its data with audio recordings, SMS, email and Twitter alerts to ensure the information can be gathered and delivered virtually real time, which, says Cirrus, makes it ideal for site managers who need to be alerted to breaches of pre-set limits as soon as possible.

Justin Baker, Cirrus Sales Manager, said: "We know from our research that the clients wanted a system that allows full integration of weather data and video recording systems so we included additional inputs and outputs specifically for this application.

"The team also ensured that the Noise-Hub² Software included allows the data to be downloaded, analysed and reports created easily and conveniently. It can run from a single PC, server or be accessed through a web interface so the data is accessible as soon as it's recorded."

Other extras introduced as standard include a new flexible calendar function that supports project planning needs. The calendar function allows different averaging periods and alerts to be set up for different times of the days/days of the week to comply with complex noise limit conditions, for example, if a project is working close to schools, public buildings or on festival sites.

For more information go to www.cirrus-environmental.com, ring **01723 891722** or email **sales@cirrus-environmental.com.**

The Invictus noise monitor

Two channel option for Brüel & Kjær Type 2270 sound level meter

Brüel & Kjær has launched a two channel option for its Type 2270 sound level meter to help users reduce time spent conducting multi-point acoustic measurements,

The new option allows both channels to receive simultaneous input, from two microphones or accelerometers. It can also receive feedback from one microphone and one accelerometer. This allows the user to carry out synchronised acoustic or vibration signal measurements, making it ideal for interior/exterior noise measurements or assessing how vibration from machinery relates to its noise output.

The two channel option is also compatible with Signal Recording Option BZ-7226. This is a signal recorder application which enables the other optional modules to record the input signal, as an attachment to a measurement project, allowing the user to identify and document sound and vibration sources, such as HVAC units, transport noise or wind turbines.

The user can play back their recordings and export the data for further analysis via Measurement Partner Suite, which is a post-processing software for the company's 2250 and 2270 sound level meters. Measurement Partner Suite automates the most common post-processing tasks, removing the need to export data to spreadsheets for analysis and saving hours of a consultant's time. In addition, the risk of errors when using and sharing spreadsheets is reduced.

Measurement data can be emailed to other users with a "pack-and-go" feature that zips and sends entire measurement archives with one click. The archive then reappears in the recipient's display automatically.

The updated software also offers a low frequency option for the 2270 and 2250 meters. With the low frequency option enabled – and the appropriate transducer selection – infrasound and building vibration measurements can be performed according to the most international standards, such as ISO 7196:1995 and ANSI S1.42–2001(R2011).

More information go to **www.bksv.com**

The Type 2270 SLM

'Lifetime plus guarantee' for Regupol range

The Regupol range of acoustic under screed materials now comes with an assurance that they will last "as long as the building they are used in".

As a recycled rubber crumb product, the range is said to have excellent resistance to compression. For example, Regupol E48, when subjected to 3 to./m2 for 10,000 minutes registered slightly over 2mm of compression, whereas an acoustic foam product used for similar applications suffered more than 7mm of compression.

The thickness of an acoustic under-screed material is a significant factor in its performance as a soundproofing layer. If, as a result of being subjected to a significant load over time, it becomes thinner, it will no longer deliver the same acoustic performance

The range is available in the UK exclusively through CMS Danskin Acoustics. It includes Regupol 7210C, Regupol E48, Regupol 6010BA, Regupol 6010SH and Regupol Quietlay.

For more details, contact Michael Sellars on **01925 577711** or at **michaelsellars@sigplc.com**

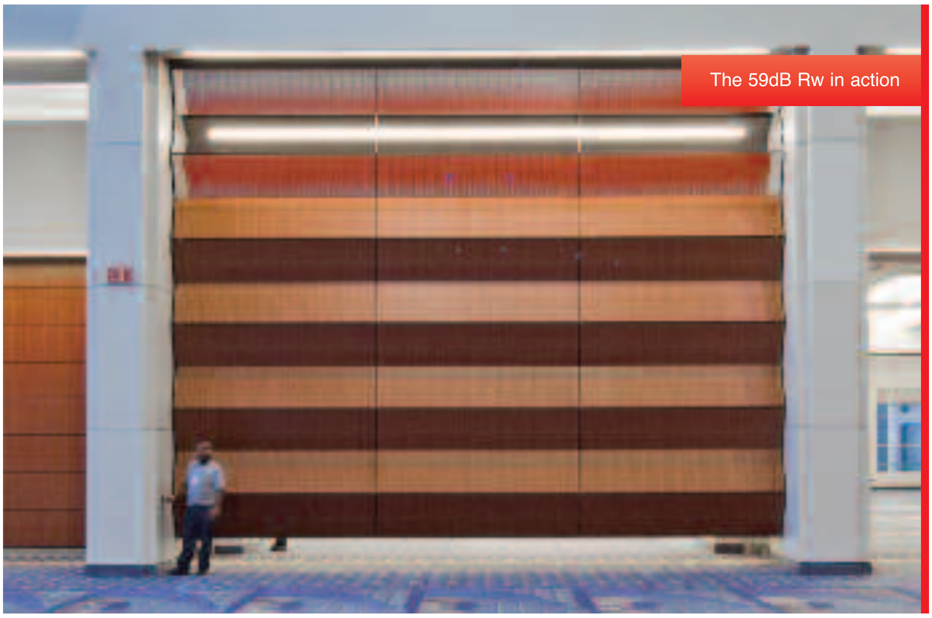
New Skyfold acoustic partition turns on the Style

Skyfold, the vertical-rising partitioning system available in the UK from Style, has launched the 59dB Rw fully automatic acoustic moveable wall.

Efrem Brynin, Style's Skyfold Product Director, said: "An automatic, moveable wall with this level of soundproofing certainly sets a new precedent.

"We have been the exclusive UK partner to Skyfold for 10 years and during this time the product has continually evolved. This new development is a very significant leap forward in acoustic technology."

For more details go to **www.style-partitions.co.uk**



The 59dB Rw in action

Live Leq makes its debut for Rion/ANV

Live Leq, Rion/ANV's web-based replacement for RCDS, is up and running on a number of important projects.

Live data is sent to the secure Live Leq website by LAN or 3G.

Alarms and limits are user-selectable and highly flexible. Up to five different simultaneous limits can be set in any user-selectable period. There is no practical limit to the number of periods a user can select per day and different limits and time periods can be set for different days of the week if required. Five minute, one hour and 12 hour LAeq limits could be set simultaneously together with, say, an LAmax and LA90 noise limit.

The Effective Remaining Limit (ERL) can be displayed showing the remaining allowable LAeq noise level for period for which an LAeq noise limit has been set (i.e. the maximum LAeq noise level which, if sustained for the remainder of the measurement period, would just not exceed the Leq noise limit).

When alarms are exceeded e-mails are sent out to recipients specified by the noise professional managing the project.

The live data is viewable in a secure website which is hosted at a UK data centre on a dedicated Raid 10 Server with overnight backups. The previous 30 days data is viewable on the secure website and older data can also be stored to the server. Key system health indicators such as the power supply voltage, memory card capacity and whether data is being stored, can be continuously displayed.

Monitoring locations are shown on a Google Maps™ interface with colour-coded icons for an immediate indication of whether limits are being, have been or are in danger of being exceeded.

Live Leq can be used as a tool for community engagement. You can give viewers access to the live data for one or more measurement positions.

A Rion NL-52 is at the heart of each Live

The Rion NL-52

Leq system and, if used outdoors, a Rion WS-15 Outdoor windshield. The Rion NL-52 has been independently type tested and achieves BS EN 61672 Class 1 with or without the WS-15 outdoor windshield.

For more information contact ANV Measurement Systems on **01908 642846** or e-mail: **info@noise-and-vibration.co.uk**

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Committee meetings 2014

DAY	DATE	TIME	MEETING
Monday	7 April	11.00	Research Co-ordination
Tuesday	8 April	10.30	CCWPNA Examiners
Tuesday	8 April	1.30	CCWPNA Committee
Thursday	10 April	11.30	Meetings
Thursday	1 May	10.30	Membership
Thursday	15 May	11.00	Publications
Wednesday	21 May	10.30	CMOHAV Examiners
Wednesday	21 May	1.30	CMOHAV Committee
Thursday	22 May	11.00	Executive
Tuesday	27 May	10.30	ASBA Examiners
Tuesday	27 May	1.30	ASBA Committee
Thursday	29 May	10.30	Engineering Division
Thursday	**12 June**	**11.00**	**Council**
Wednesday	18 June	10.30	CCENM Examiners
Wednesday	18 June	1.30	CCENM Committee
Thursday	19 June	10.30	Distance Learning Tutors WG
Thursday	19 June	1.30	Education
Thursday	17 July	11.30	Meetings
Tuesday	5 August	10.30	Diploma Moderators Meeting
Thursday	14 August	10.30	Membership
Thursday	4 September	11.00	Executive
Thursday	**11 September**	**11.00**	**Council**
Thursday	25 September	10.30	Engineering Division
Monday	29 September	11.00	Research Co-ordination
Thursday	16 October	10.30	Diploma Tutors and Examiners
Thursday	16 October	1.30	Education
Thursday	23 October	11.00	Publications
Thursday	30 October	10.30	Membership
Tuesday	4 November	10.30	ASBA Examiners
Tuesday	4 November	1.30	ASBA Committee
Thursday	6 November	11.30	Meetings
Thursday	13 November	11.00	Executive
Wednesday	19 November	10.30	CCENM Examiners
Wednesday	19 November	1.30	CCENM Committee
Thursday	20 November	11.00	Publications
Tuesday	2 December	10.30	CCWPNA Examiners
Tuesday	2 December	1.30	CCWPNA Committee
Thursday	4 December	11.00	Council

Refreshments will be served after or before all meetings. In order to facilitate the catering arrangements it would be appreciated if those members unable to attend meetings would send apologies at least 24 hours before the meeting.

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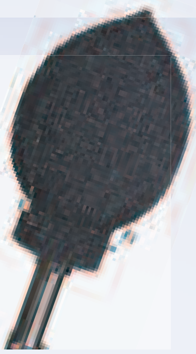
- Live Data to a secure website
- E-mail alarms
- Independently Type Tested to IEC 61672 Class 1
- Community Engagement
- Set up viewers to see Live Data
- Continuous Monitoring of System Health

RION WS-15

"Oversize Double-Layer Proprietary Windscreen"



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RION NL-52

A Complete Solution for Environmental Noise Measurement

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- Uncompressed Audio Recording NX-42WR(Option)
  - Continuous
  - Manual Start /Stop
  - Triggered by up to 4 User Selected Levels (different triggers for different times)
- Periodic Samples (including 2 minutes – Perfect for Windfarm Compliance)
- Real Time Octaves/Third Octaves NX-42RT(Option)
  - Full Logging Functionality Maintained but in Octaves or Third Octaves
- Narrow Band FFT Analysis NX-52FT (option)
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- Independently Type Tested to IEC 61672 Class 1

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ANV MEASUREMENT SYSTEMS

NNR-03 Noise Nuisance Recorder

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